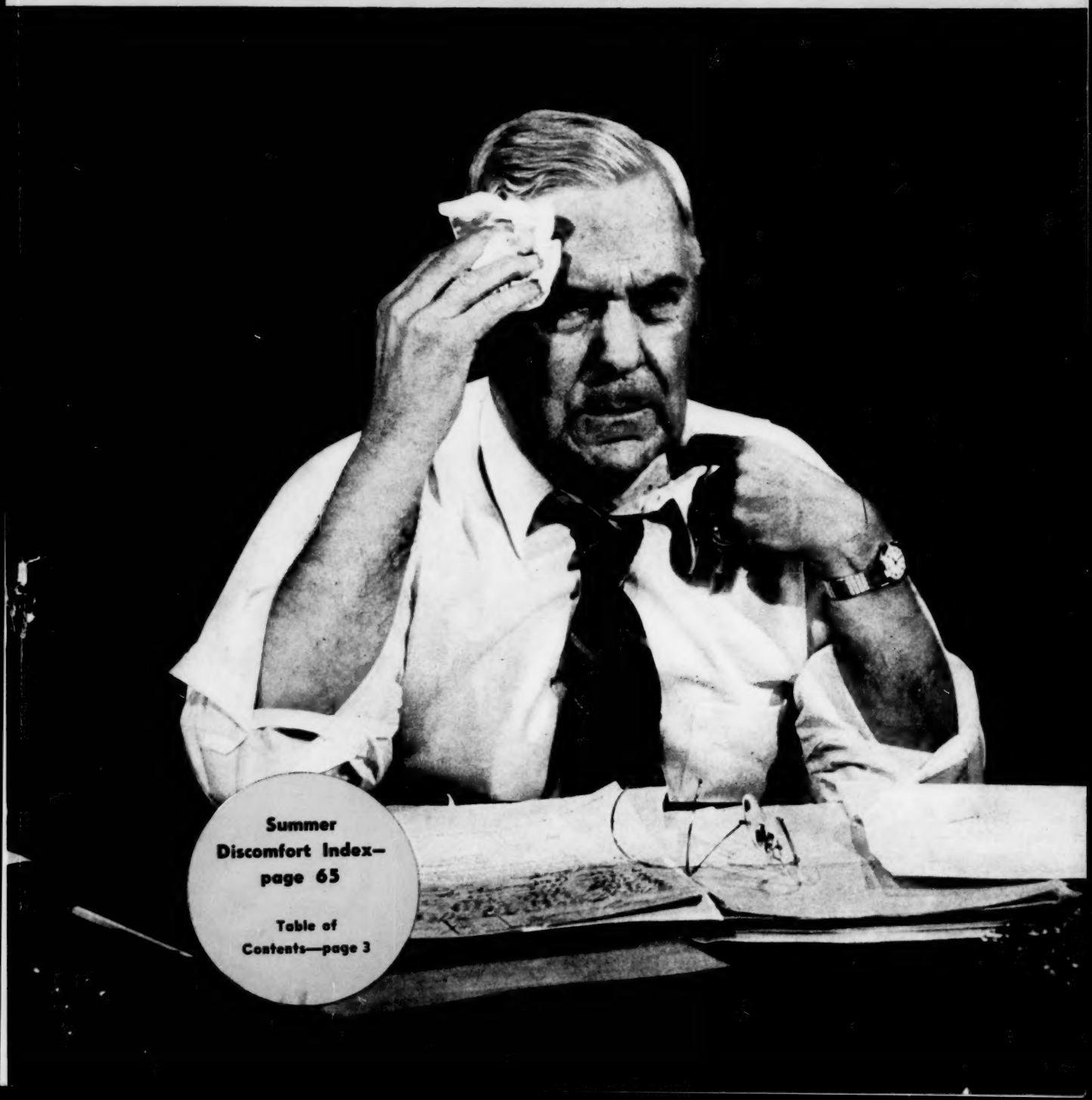
AIR CONDITIONING HEATING AND VENTILATING

AUGUST, 1956 – 53rd YEAR



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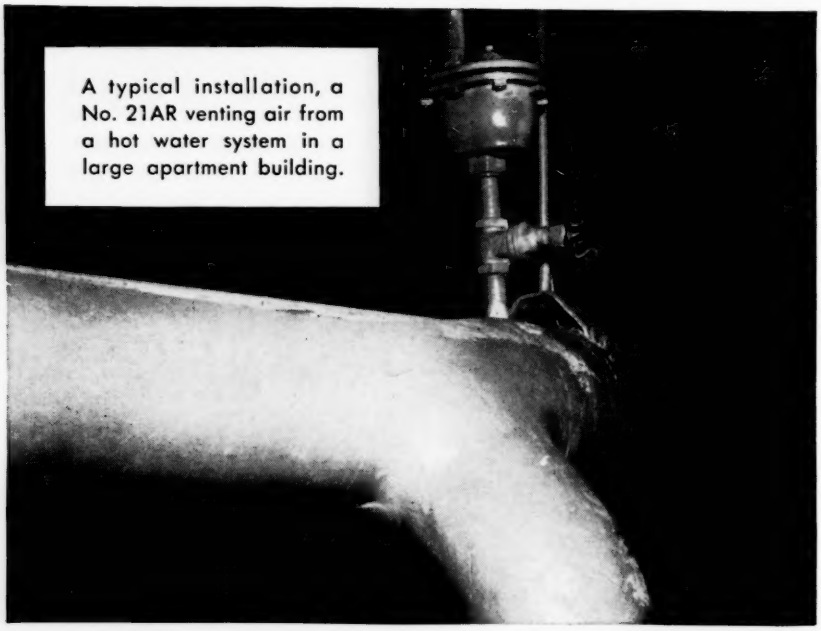
.....for Trouble Free Air Venting .....



A typical installation, a No. 21AR venting air from a hot water system in a large apartment building.

Armstrong Ball Float Traps

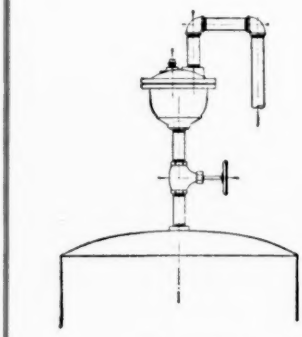
Here's what you get when you install Armstrong Ball Float Traps for air venting service:

- **NON CLOGGING –**
  Installed above flow, no lime deposits, scale or other foreign particles can impair the operation of these traps.
- **NO ADJUSTMENTS –**
  Install them only, they are completely automatic. Nothing to adjust.
- **INSTALL THEM, THEN FORGET THEM –**
  Stainless steel, simple internal mechanisms actually cut maintenance costs to the nub. Look forward to years of dependable service without maintenance.
- **MODERATELY PRICED –**
  Mass production economies are passed on to you by using the same basic parts for steam traps, moisture drainage traps and air relief traps.

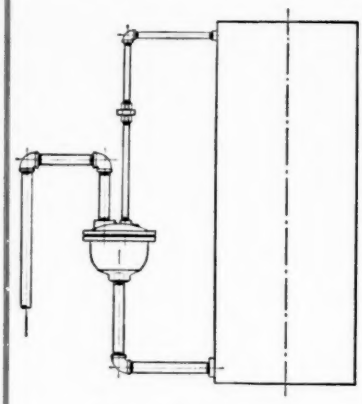
All Armstrong traps are sold and serviced by qualified Representatives throughout the country. All are unconditionally guaranteed to satisfy.

Ask for Bulletin No. 450 –
Shows typical installations, types, sizes, and prices for cast semi-steel traps and forged steel traps. See your local Armstrong Representative or write:

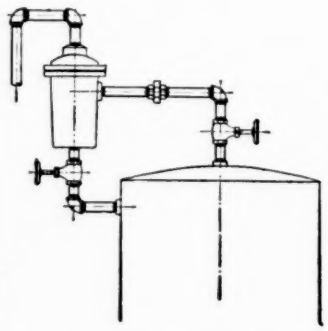
ARMSTRONG MACHINE WORKS
846 Maple Street, Three Rivers, Michigan



Air venting
a hot water heating system.



Venting surplus air
from a water storage tank.



Hook-up for venting
large amounts of air.

ARMSTRONG BALL FLOAT TRAPS

THIS HAND BEATS ALMOST ANY AIR OR FUME EXHAUST PROBLEM

Beat noise . . . with the DeBothezat *Centrifugal* Roof Ventilator. Runs at low tip speeds, moves large volumes of air efficiently against static pressure. Low in silhouette, blends well with modern architecture.

Beat oil and dust-laden air . . . with the *Vertical Discharge* Roof Ventilator. Exhausts air straight up at high velocity. Keeps harmful residue from attacking the roof.

Beat most industrial air removal problems . . . with the *Power-Flow* Roof Ventilator. Ruggedly built unit in an aerodynamically correct, weather-proof housing.

Beat hot, flammable, corrosive fumes . . . with the *Bifurcator*®. Fumes bypass the motor (located in an isolated chamber) which always stays clean, cool and accessible.

Send for bulletins on DeBothezat fans for your problems.

De Bothezat FANS
A DIVISION OF
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

----------MAIL COUPON TODAY----------

DeBOTHEZAT FANS DIVISION, Dept. HV-856
American Machine and Metals, Inc.
East Moline, Illinois

Please send me a complete catalog on each of the following DeBothezat fans:

- ☐ Centrifugal Roof Ventilator
- ☐ Vertical Discharge Roof Ventilator
- ☐ Power-Flow Roof Ventilator
- ☐ Bifurcator

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ADDRESS _____

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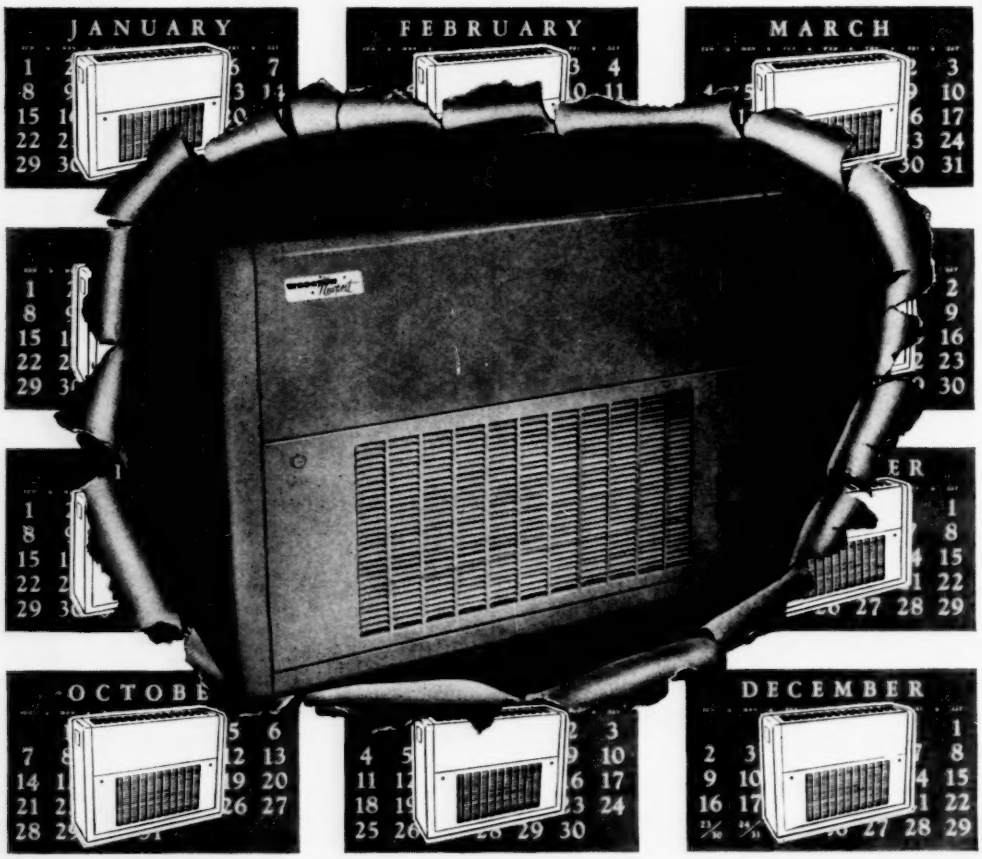
ATTENTION MR. _____

The ALL-NEW

WEBSTER Newport

- Economical through-the-wall units . . . no blocking of windows
- Ideal for hotel, office building, apartment or motel modernizing
- Easily installed without loss of overnight revenue
- Ties into any present steam or hot water heating system . . . air-conditions the year 'round

for all-season heating and cooling



Out go the radiators . . . in come these modern, compact, practical cabinet-type units to complement any interior, bring new appeal to every room. Connects to the present piping system. Completely self-contained, hermetically sealed cooling cycles require no water, no cooling towers.

For more of the exciting details about the all-new Webster Newport, see your Webster Representative or write for bulletin. Address Dept. HV-8.

WARREN WEBSTER & COMPANY
Camden 5, New Jersey

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Webster
HEATING AND COOLING
EQUIPMENT
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AIR CONDITIONING HEATING AND VENTILATING

AUGUST, 1956

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The Cover: The man at his desk is showing his reaction to summer heat. Photo by H. Armstrong Roberts. See article beginning on page 65.

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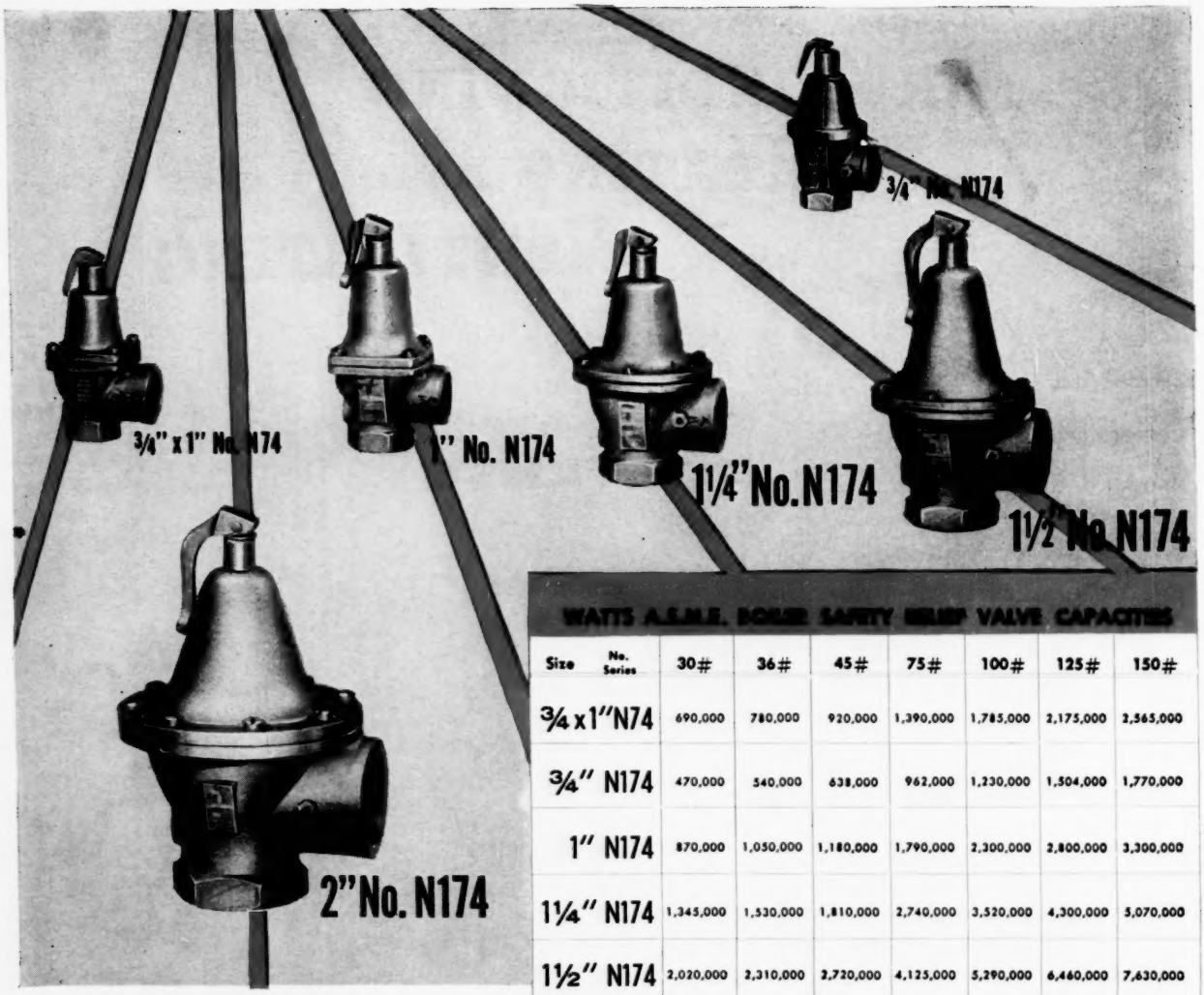

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Size / No. Series	30#	36#	45#	75#	100#	125#	150#
¾ x 1" N74	690,000	780,000	920,000	1,390,000	1,785,000	2,175,000	2,565,000
¾" N174	470,000	540,000	638,000	962,000	1,230,000	1,504,000	1,770,000
1" N174	870,000	1,050,000	1,180,000	1,790,000	2,300,000	2,800,000	3,300,000
1¼" N174	1,345,000	1,530,000	1,810,000	2,740,000	3,520,000	4,300,000	5,070,000
1½" N174	2,020,000	2,310,000	2,720,000	4,125,000	5,290,000	6,460,000	7,630,000
2" N174	3,815,000	4,360,000	5,130,000	7,770,000	9,970,000	12,170,000	14,370,000

WATTS COMPLETE LINE

OF A.S.M.E. RATED WATER PRESSURE RELIEF VALVES FOR WATER HEATING BOILERS

Regardless of size or capacity, you can supply every job from the Watts line—the only complete line. Six different sizes and many graded pressure settings with corresponding BTU/HR discharge capacities are available. Nearly every boiler can be protected with only one Watts safety relief valve because of this practical selection.

We made the first non-metallic disc-to-metal seated ASME rated water pressure safety valves and also the first guideless, stickage-free design.

Stocked by your wholesaler — Write for Folder F174.

WATTS REGULATOR COMPANY

Plumbing and Heating Safety Valves and Controls

Since 1874

LAWRENCE, MASSACHUSETTS

HIGH SPOTS

• Manufacturers' **shipments of plumbing fixtures** during the first quarter of 1956 amounted to $89 million. This represents an increase of 5% over the fourth quarter of 1955, which amounted to $84.6 million.

• An agreement **transferring the air conditioning division** of Union Asbestos & Rubber Company to National-U. S. Radiator Corporation has been signed by both companies. See page 144.

• The National Better Business Bureau is recommending that all national advertising offering **7½-amp room air conditioners should not use unqualified claims** stating or implying that no changes or alterations in existing electrical installations are needed.

• **C. M. Woolley,** former chairman and one of the organizers of American Radiator and Standard Sanitary Corporation, died last month at the age of 92 in California. See page 144.

• The sheet division of **The Aluminum Association has adopted** American Standard Association's **preferred thicknesses** for uncoated, thin, flat metals as set forth in ASA B32.1-1952.

• The **first national conference on applied heat transfer** will be held next year under the sponsorship of the heat transfer division and the Central Pennsylvania Section of the ASME. See page 144.

• A **woven asbestos suit** with a coating of aluminum and undercoating of glass wool was **demonstrated in an oven fired to 1700 deg F.** The suit will permit repairs to be made to ovens and boilers without going to the expense of cooling them off and firing them up again.

• Final Congressional **approval has been given** by the Senate to legislation authorizing **a study of air pollution** in the New York-New Jersey metropolitan area.

• **A device that records** the amount and intensity of **solar energy** has been continuously tracking the sun at Miami, Florida, for two years. See page 70.

• **Rail shipments of anthracite** to the New York Harbor area, Philadelphia, and Toronto **declined over 65%** in total tonnage between 1946-1947 and 1954-1955.

• A tract of approximately 550 acres of land near Gaithersburg, Maryland, has been selected for **relocating the Washington laboratories** of the National Bureau of Standards in order to replace present research facilities.

• **Ionizing radiation** is being studied at Armour Research Foundation of Illinois Institute of Technology as **a possible method of sterilizing sewage** containing bacteria, viruses, fungi, and toxins.

WASHINGTON OVERTONES

by LORING OVERMAN

Overtones from Washington were particularly loud during July. Echoing half a dozen different notes, they sent their vibrations into commerce, industry, and homes.

• Keynote of the political scale was President **Eisenhower's decision** to continue the **race for reelection.** With the Eisenhower-Nixon ticket a reasonable conclusion, party members can turn their thoughts to issues, platforms, and places on the Congressional team.

• Assuming for the moment that Ike and Dick will be elected, a new political element appears. For the first time, a President would be functioning under the 22nd Amendment, which **limits Presidential tenure** to two terms. Question is whether Presidential persuasion would be as convincing to Senators and Congressmen as when running for a third or fourth term is a possibility.

• A noisy finale with many overtones was presented during closing hours of the 84th Congress. Working far into the night on "must" legislation, Senators and Congressmen seemed to have some difficulty determining which baton to follow. The political score directed by President Eisenhower was so similar to that of the opposition party that it seemed hard to determine which would receive credit, or blame, for passage or defeat of a given measure.

• Result: At deadline time for this column, it appeared that **housing** legislation, social security expansion, **school aid** funds and several other controversial measures would be **carried over** for consideration by the new 85th Congress.

• When the new Congress convenes in January, everything on the agenda will be **new business.** Things left undone by the 84th die with adjournment. So starting from scratch, with new hearings preceding action, the 85th may be expected to consider:

• **New Budget,** considerably larger than the $66 billion estimated for the fiscal year ending June 30, 1957. Increased total—unless cuts can be made somewhere along the line—stems from new expenditures authorized by 84th Congress. Among these: Additional $2½ billion for farm price supports; new highway trust fund which draws $2 billion from general fund; pollution control bill costing $50 million a year, and $900 million voted to Defense Department.

• **Tax Cuts** might be considered more objectively (less politically) in a no-election year. Cut could come as a shot in the arm if business turns downward, or as a bonus if continuing good business puts a surplus in the federal Treasury.

• **Housing.** Always a popular topic, and one of importance to the heating industry. In mid-July it appeared that public housing features of the 1956 legislation would prevent its passage by the House. The Senate had approved liberalized FHA home improvement loans; provisions for elderly persons to buy homes, and authorization for up to 500,000 units of public housing, at a rate of 135,000 per year. House bill called for 180,000 units of public housing, over a three year period. Administration asked for 35,000 units yearly for two years.

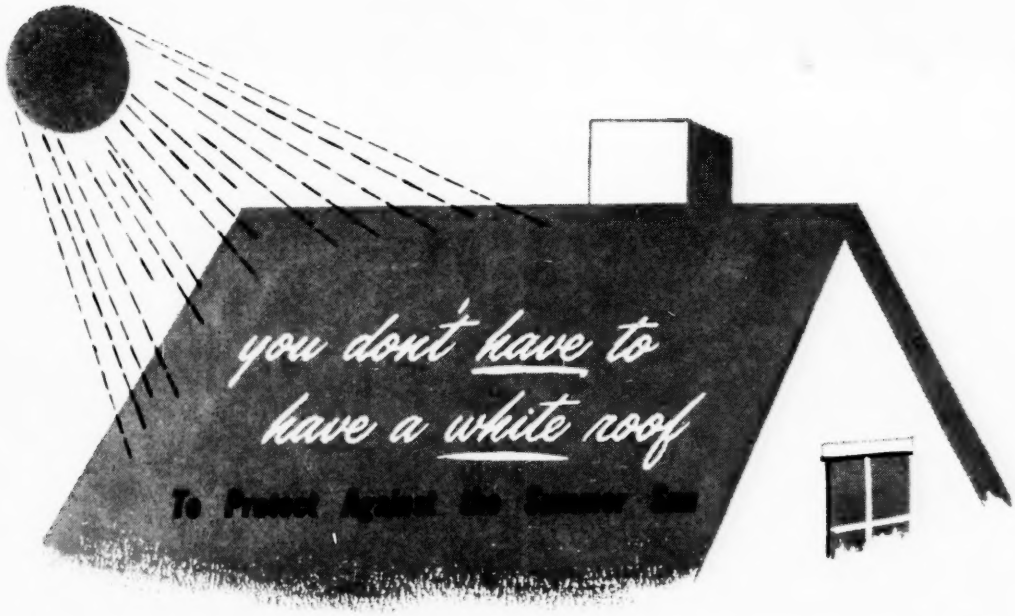
• **Aid to Schools** will be another lively topic of consideration by members of the 85th Congress. Segregation is an issue here, together with opposition from those who contend that "what the government subsidizes, it must control."

• **Minimum Wage** legislation will propose broader coverage, particularly for employees of retail and service businesses.

• **Hoover Commission** recommendations to cut Government costs by simplifying operations—at a promised saving of some $5 billion—will again be proposed by those who feel that much fat can be trimmed off. Washington views these proposals with little enthusiasm; businessmen must apply the necessary pressure from the grass roots.

• **Foreign Aid** funds, in the sum of approximately $4 billion annually, will again come up for consideration, as will proposals to continue foreign trade agreements.

(*Continued on page* 8)



The summer sun pours down as much as 250,000 Btu's of heat per hour on a 1,000 sq. ft. roof of a house at noon on a clear day. Some white shingles can reflect, OUTDOORS, about 55% of the sun's rays; yellow shingles 35%, green 15%, red 14%, blue 5%, black 4%.

White shingles won't always stay white, don't always harmonize with the color-scheme, easily look soiled. So despite the greater efficiency of white (which is true only OUTDOORS), roofs may nevertheless be ANY color; and the house will still be considerably cooler than the outside; IF MULTIPLE REFLECTIVE spaces and reflective surfaces are installed beneath the roof.

The comfort and efficiency of this scientific combination, produced by multiple sheets of aluminum and fiber, air-spaced apart, is remarkable for its effectiveness in repelling radiation, which is responsible for about 93% of all *heat in-flow* down from the roof to living quarters. The surfaces of the aluminum reflect radiation with a 97% rate, and absorb and emit radiation at a rate of only 3%.

Since there is NO convection in down heat flow, and slight conduction through low density air spaces, a triple barrier to *heat in-flow* is raised. Summer coolness and comfort are enhanced, night and day, often 15° F cooler than the shade outdoors, for the slight cost of the *insulation alone.*

ALSO RETARDS WINTER HEAT LOSS

In winter too, this form of insulation is effective, because 55% to 70% of heat flow upwards through air space is by radiation. Convection, ranging to 45%, is retarded by the multiple aluminum sheets. In up heat flow, conduction is also slight because of air's low density.

The best shingles or most beautiful paint job on the exterior or interior, will not protect against peeling paint, timber rot, and crumbling plaster caused by destructive condensation.... The multiple aluminum, almost impervious to water vapor, minimizes condensation formation on or within it by its scientific construction.

HOW SOLAR RADIATION IS ABSORBED by the outer surfaces of roofs and walls, transformed into heat which flows by conduction through the solid material to the inside surfaces, and again transformed into heat rays which flow inwards, is interestingly and authoritatively discussed in a chapter of the new 48 page manual, "Heat Flow by Radiation in Buildings," by Alexander Schwartz. The author points out among other things, that while white paint, white brick, etc. perform well outdoors, in an *enclosed* space they are no better than black paint. (Use the coupon for a copy.)

INFRA INSULATIONS CAN BE PURCHASED everywhere through your preferred local dealer for 3¢ to 12¢ per sq. ft. depending on the type.

Infra Insulation, Inc., 525 B'way., New York, N. Y.
Dept. V-8

Please send "Heat Flow by Radiation."

Name_____

Firm_____

Address_____

WASHINGTON OVERTONES (*Continued from page 6*)

• How the 85th Congress will vote on these and other important subjects will depend upon the instructions given by voters. Suggestion—register, and vote.

• **Operation Alert**—a one week Civil Defense project in which government people participated beginning July 20—had a touch of realism added by the steel strike. The project, simulating an all out nuclear attack on several cities of the United States, was to test government and defense operations under dispersal conditions. Also contemplated was an assessment of bomb "damage" to industry and to the civilian population.

• The **steel strike,** effective June 30, "knocked out" the bulk of the nation's steel production capacity, idled 650,000 steel workers, and within days was spreading unemployment and non-productivity to related industries.

• In place of simulated orders, several government agencies issued steel-conservation orders "for real."

• Warehouse stocks of aircraft quality and other steels were frozen.

• Disappearance of titanium stocks, expected within 30 days after July 1, were cause for concern among air force suppliers.

• General Services Administration ordered all **government agencies to discontinue sale or donation of steel pipe, plates, sheets,** shapes and concrete reinforcements until further notice.

• Other moves to channel remaining steel stocks into defense production are under consideration, and a complete reappraisal of stockpiling procedures is anticipated.

• Meanwhile the impact of the steel strike, whether real, fancied, or anticipated, had begun by mid-July to brake the overall economy.

• **Industrial production,** after remaining close to record levels in June, dropped slightly in early July. A 5% dip for the month is anticipated, according to Federal Reserve Board estimates.

• **Heaviest impact** of a continuing steel strike, FRB observes, would be in construction rather than industrial production. Spotty shortages could become apparent by August. Conversely, if the strike is settled, new auto models and a resumption of industrial and construction activity could carry the index to new highs late this year.

• **Housing starts** were off again in June—to 104,000 units. Government forecasters now estimate a total of 1,000,000 housing starts for the year 1956.

• **Construction totals** for the first half of 1956 amounted to $19.9 billion—2% over the same period of 1955. Seasonally adjusted, construction spending for the first half of the year was at the annual rate of about $43.5 billion. This is a billion dollars under the $44.5 billion set for the entire year by the government estimators.

• Continuing an upward movement started in 1950, sales of **distillate fuel oils** increased from 526,245,000 barrels (42 gallons) in 1954 to a record 581,595,000 in 1955. Sales of residual grades, advanced to 556,515,000 barrels in 1956, from 520,714,000 in 1954.

• A new **high for electric utilities' production** of energy was reported for the 12 month period ended May, 1956, according to the Federal Power Commission. Total was 578,406,927,000 kwh—1% above the 12 month period ended the preceding month, and 16.2% over the year ended May 31, 1955.

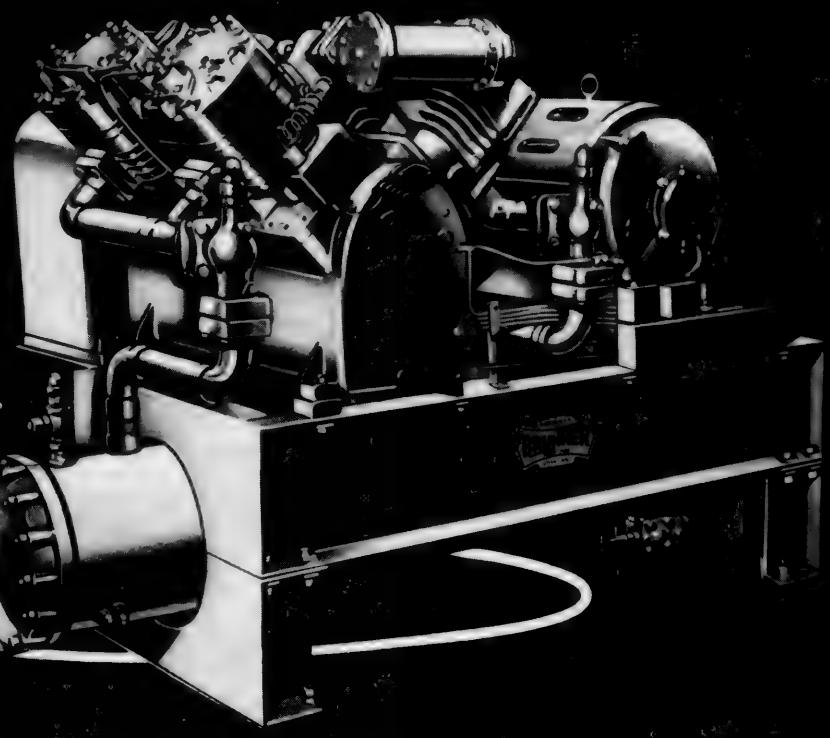
• Application to charter 30 Liberty **ships to carry American coal** abroad has been filed by the American Coal Shipping Co. The company is composed of officials of coal producing companies, coal-carrying railroads, and the United Mine Workers of America.

• Interior Secretary Fred A. Seaton has announced the reappointment of eight members of the Military Petroleum Advisory Board. They will serve three years. The 27-man board provides the Interior and Defense Departments with counsel and information on oil and gas matters relating to national security.

1906

Engineered for entertainment, the stereoscope . . . popular in 1906 . . . was the forerunner of modern 3-D photography. It was in 1906 that the first *Brunner-engineered* product was built.

TODAY Brunner engineering offers the most complete line of Air Conditioning Condensing Units available from a single source.



Whether the job be large or small, there's a *right* Brunner Condensing Unit for every remote Air Conditioning application. Complete size range from ¼ H.P. through 100 H.P. Self-contained BAC units in 3, 5, 7½ and 10 H.P. models.

ALSO AVAILABLE

AIR-COOLED CONDENSING UNIT FOR OUTDOOR INSTALLATION —in 2-, 3- and 5-ton capacities, with protective shelter.

PROVEN QUALITY
50th Anniversary
BRUNNER
SINCE 1906
DEPENDABLE

BRUNNER MANUFACTURING COMPANY, UTICA, N.Y.

The Brunner Co., Gainesville, Ga. In Canada: Brunner Corp. (Canada) Ltd., Toronto, Ontario

BRIEFLY STATED

• The construction of new office and warehouse buildings in Detroit and Houston has been begun by The Powers Regulator Co., Skokie, Ill. The Detroit building will be occupied by **D. T. Randall & Co.,** agents.

• Announcement is made by The Trane Company's New York City sales office that **Henry E. Woodward** has been added to its staff as a sales engineer. During the past seven years, Mr. Woodward was a district sales representative in Detroit for the air conditioning and refrigeration division of a major manufacturer.

• Bush Mfg. Co., West Hartford, Conn., and Heat-X, Inc., Brewster, N. Y., have appointed **Alvin S. Vener** as a sales engineer in the San Antonio, Tex., area. Mr. Vener was formerly associated with Coolidge-Locher Co., Corpus Christi air conditioning contractors, as a sales engineer.

• Sales personnel from the special military products and commercial portable heater departments of **American Air Filter Co., Inc.,** moved recently from Moline, Ill., to Louisville, Ky. The transfer will bring together all of the company's sales departments with the exception of its three subsidiaries—Famco, Inc., Illinois Engineering Co. and AAF of Canada, Ltd.

• **George E. Bosch** has joined the sales staff of Ingersoll Conditioned Air Div., Borg-Warner Corp., Kalamazoo, Mich. Mr. Bosch will be in charge of sales and product development for the air distribution and diffuser program.

• **Stanley L. Abrams,** assistant to the executive vice-president of Emerson Radio and Phonograph Corp., has been elected president and a director of Quiet Heet Mfg. Corp., a wholly-owned Emerson subsidiary. The firm, located in Newark, N. J., manufactures room, residential. and commercial air conditioners as well as oil burners.

• **Hal O. Chamberlain** has been named to the newly created position of manager of zone control sales for Minneapolis-Honeywell Regulator Company. For the past year and a half, Mr. Chamberlain has been assistant sales manager of Honeywell's home products division.

• **Raymond Mower Conner,** consultant for the American Gas Association Laboratories, retired after 41 years of service to the American gas industry. Mr. Conner contributed greatly to the growth of the gas industry's national standards for gas appliances and accessories and to the success of the gas industry's national gas appliance testing agency.

• **Karl W. Galliger** has been appointed director of engineering of The New York Air Brake Company. In his new capacity Mr. Galliger will be responsible for company research and engineering, and for organization policies, procedures and development programs of the engineering departments of all divisions of the company. He will be located in New York.

• **R. A. Morgan** has been appointed manager of advertising and sales promotion for Westinghouse Electric Corporation's apparatus division in Pittsburgh, Pa. Mr. Morgan succeeds Drayton Heard, Jr., who has been named manager of the power use section, electric utility sales department, East Pittsburgh, Pa.

• **Thomas J. Farrahy, Jr.,** has been appointed assistant manager of the industrial advertising and sales promotion department of Westinghouse Electric Corp., Pittsburgh, Pa. Mr. Farrahy, formerly division manager in charge of electric utility and defense activities for the industrial advertising department, succeeds O. C. Kebernick who has been named administrative assistant to the manager of commercial atomic power activities for Westinghouse.

• The appointment of **Daniel J. Wiener** as sales manager is announced by Century Products, Inc., Cleveland, Ohio. Mr. Wiener was previously advertising and sales promotion manager of the company.

• Joy Mfg. Co., Pittsburgh, Pa., has announced the appointment of **John P. Cartwright** as sales manager, industrial sales. Mr. Cartwright will headquarter in the company's general offices in Pittsburgh.

• **Walter P. Barrett** has been appointed manager of the pipe fabrication department of Dravo Corporation's machinery division. His headquarters will be at the firm's Pittsburgh office. Mr. Barrett joined the company in 1935 and has served in sales and administrative capacities.

• Plans for a general expansion of operating facilities have been announced by **Flexible Tubing Corp.,** Guilford, Conn. Approximately 5000 square feet of warehouse space will be added to the Guilford plant. The company also is developing plans for expanding its Western operations in Los Angeles to include manufacturing of additional types of ducting used in the aircraft field.

• Three more building projects have been approved by **The Trane Company's** directors for construction starts during mid- and late summer. The new projects include a 5040-sq ft addition to the research and testing laboratory, a 45,000-sq ft warehouse building and a 4800-sq ft paint storage building. The company's construction activity in La Crosse, Wis., this year totals 241,800 sq ft of new manufacturing space and buildings.

• **United States Air Conditioning Corporation** has moved its main offices and plant from Minneapolis to Philadelphia. Operations have been established in the plant acquired by the company in January when it purchased the Jordon Refrigerator Co., Inc., which is now a subsidiary.

• **Paul L. Stauffer** was elected president of Lancaster Pump & Mfg. Co., Inc., Lancaster, Pa., at a reorganization meeting of shareholders held recently. He succeeds Kurt H. Aronsohn who died earlier this year. Mr. Stauffer was the former executive vice-president of the company.

(*Continued on page* 12)

CONCEIVED WITH IMAGINATION
BUILT FOR A LIFETIME . . .

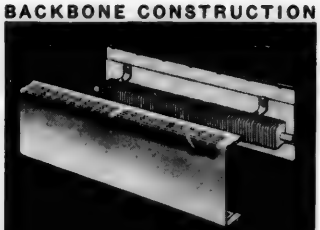
NESBITT SILL-LINE RADIATION

NESBITT SILL-LINE RADIATION is the fulfillment of an ideal.

For so it began—as a *concept* of protective comfort along
the cold front of a living or working enclosure—
fin-and-tube convector-radiators at the sill or wall perimeter—
encased to look more like fine furniture than heating equipment—
designed for low-cost installation in a high-wage era—
built to outperform and outlast conventional products—
and backed by an honored name in the realm of thermal comfort.
How well Nesbitt has succeeded in translating image to reality
is confirmed by architects' preference for Sill-line Radiation.

Send for Publication 102

BACKBONE CONSTRUCTION



MADE AND SOLD BY
JOHN J. NESBITT, INC.
PHILADELPHIA 36, PA.

BRIEFLY STATED

(*Continued from page* 10)

• **A. F. Siers** has joined Air-Maze Corp., Cleveland, Ohio, as a factory representative. Mr. Siers will handle special accounts in Ohio and Michigan.

• Marlo Coil Co., St. Louis, has announced the appointment of **Ward & Black Engineering Sales** as its representative in the Pittsburgh, Pa., area. Principals of the firm are **L. C. Ward** and **Robert Black.**

• **Robert G. Werden** has been named North Atlantic district manager of York Corporation. Mr. Werden will have his offices in New York City.

• The Trane Company has announced that **Gary Mays** has been appointed sales representative in charge of a new sales sub-office in Albuquerque, N. Mex.

• **The Petroleum Heat and Power Co., Inc.,** Stamford, Conn., will act as wholesale distributor for Worthington Corporation's line of air conditioning and refrigeration products. The company will represent the sale of Worthington products in Nassau, Suffolk and Westchester Counties, N. Y., and in Fairfield County, Conn.

• **M & V Supply Company** has been appointed distributor in the Oklahoma area for Refrigeration Engineering, Inc., Los Angeles. **A. R. Morin** and **M. W. Voss** are co-owners of the company with offices in Oklahoma City.

• Graver Water Conditioning Co., New York, N. Y., has opened a new sales and service office in Boston to serve the New England area. **William A. Homer** will be district manager in charge of the office.

• The Fairbanks Co., New York, N. Y., announces the appointment of **John E. Bates** to the position of New England branch manager.

• **Donald E. Jaekle,** formerly of Seymour, Conn., has been assigned to the Philadelphia sales office of The Trane Company, La Crosse, Wis.

• Major personnel appointments affecting Crane Co. branches are: **Harold H. Stift** has been named manager of the branch at Chicago; **Frank R. Perry** has been appointed manager of the Los Angeles branch; and **Leo F. Regan** has been appointed to the newly created post of assistant branch manager at Springfield, Mass.

• **Delaware Valley Engineering Co., Inc.,** Philadelphia, Pa., has been appointed distributor by Automatic Switch Company of its solenoid valves in Delaware, southern New Jersey, and eastern Pennsylvania.

• **Floyd B. Watts** has joined Sporlan Valve Company's field sales organization. For the present, he will work with J. J. Mays out of the company's Dallas office in order to expand coverage in the Texas, Oklahoma, Arkansas, and Louisiana area.

• Appointment of new sales engineers in New York, Washington, and Minneapolis was announced by The Powers Regulator Co., Skokie, Ill. Named are **William P. O'Connor,** New York; **George J. Salmon,** Washington; and **Leo P. Christiansen** and **Finn Litsheim,** Minneapolis.

• **Mason M. Roberts,** General Motors vice-president and head of Frigidaire division, has elected to retire and is being succeeded by **Herman F. Lehman,** general sales manager of Frigidaire. Mr. Roberts is terminating 44 years of service with General Motors Corporation and 31 years with the Frigidaire division.

• **R. A. Darling,** Wheat Ridge, Colo., has been appointed sales representative for Colorado, Wyoming, western South Dakota, and western Nebraska by J. F. Fritchard and Company of California, Kansas City, Mo.

• The appointment of **Henry J. Linskey** as sales engineer for the Philadelphia-Wilmington area is announced by Thatcher Furnace Co., Garwood, N. J. Mr. Linskey will be responsible for dealer sales-service in the territory.

• **Thomas D. Kelly** has been appointed manager of Crane Company's midwest district, and **Darrel R. Nordwall** has been named manager of the company's east coast district. The new manager of valve and fitting sales is **Charles H. Lovelace.**

• **Russell G. Creviston,** Crane Co. executive, retired after twenty-seven years at the company's general office in Chicago. Mr. Creviston joined Crane as manager of sales promotion and served as director of advertising and sales promotion before being named director of public relations in 1943. Before joining Crane Co., Mr. Creviston had been director of the Plumbing and Heating Industries Bureau.

• Joy Mfg. Co., Pittsburgh, Pa., has announced the appointment of **William Hanson, Jr.,** as manager of conveyor products at the new Philadelphia plant.

• **Robert K. Eskew,** a 23-year veteran of Servel, Inc., has been named chief engineer for year-round gas air conditioning. Mr. Eskew moves up from product director.

• **Robert L. Gibbs** has been promoted to the position of general sales manager of Mueller Brass Co., Port Huron, Mich.

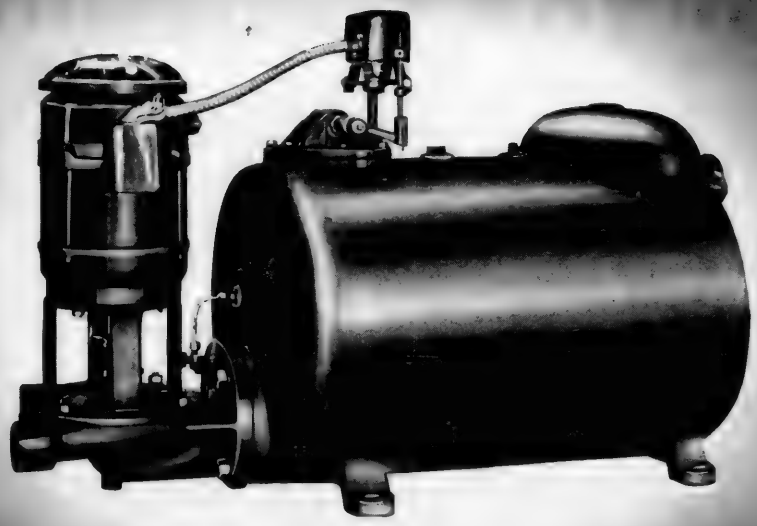
• The fan and blower division of The Peerless Electric Co., Warren, Ohio, announces the appointment of **The Paller Engineering Co.,** Indianapolis, Ind., as factory representative in that area.

• The board of directors of **The Humphryes Mfg. Co.,** Mansfield, Ohio, a producer of plumbing ware, recommended to its stockholders that the 74-year-old concern be merged with Borg-Warner Corp. The consolidation would be effected through an exchange of stock. Approval of the merger will represent another step in Borg-Warner's expansion in the home building and home equipment fields. Borg-Warner acquired York Corp. in June.

SKIDMORE PUMPS

set the pace in performance *

TYPE VC PUMP



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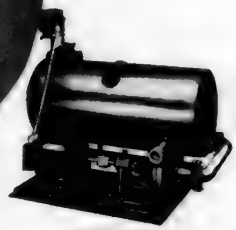
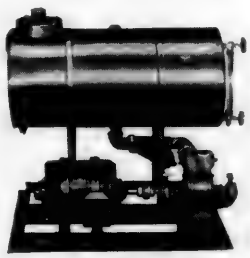
TYPE UV
Bulletin No. 19-A



TYPE HS
Bulletin No. 14-A



TYPE TM
Bulletin No. 17

*SKIDMORE PUMPS HAVE SET A STANDARD FOR PERFORMANCE AND DEPENDABILITY SINCE 1921.

QUIET OPERATION

Further evidence of Skidmore's top quality engineering and knowledge of sound design is its quiet operation endowed in every Skidmore Pump.

LOW INLET CONNECTION

Suited to its specified capacities and pressures for efficient operation in every case—pump is provided with low inlet connection to render additional service and reduce installation costs for low floor returns.

ACCESSIBILITY FOR INSPECTION

Like all Skidmore Pumps the VC unit is built for dependability and freedom from troubles—is readily accessible for inspection or service without disturbing pipe connections.

Call your nearest Skidmore Pump Representative or — write for bulletins

SKIDMORE CORPORATION • ST. JOSEPH, MICHIGAN

AIRCOUSTAT* sound traps layout for controlling

AIRCOUSTAT SILENCES ALL FREQUENCIES IN THE AUDIO-FREQUENCY RANGE
Resonators hold low-frequency sounds
Periodic internal structure dampens middle-frequency noise
Sound-absorbent materials suppress high frequencies

simplify design and air conditioning noise

THIS 5-FT. AIRCOUSTAT REPLACES 80 FEET OF ORDINARY DUCT LINING

AIRCOUSTAT saves you time on the job because it's pre-engineered . . . and fits acoustically if it fits geometrically. AIRCOUSTAT is quick and easy to install . . . no special tools are required.

Most Efficient Solution

AIRCOUSTAT's power to deaden sound is unmatched by other sound control methods devised for air conditioning systems. Acoustical performance is *guaranteed*. Efficiency is more than 13 times that of ordinary lining. And AIRCOUSTAT provides a lower flow resistance and less pressure drop than other sound control methods.

AIRCOUSTAT suppresses sound in low-velocity air conditioning systems . . . will silence an entire system or selected outlets. AIRCOUSTAT units fit any size of duct within the range of unit sizes . . . adapt themselves to any shape of duct.

Cost You 50% Less

AIRCOUSTAT units cost you as much as 50% less than ordinary duct lining . . . with savings in time and labor costs. AIRCOUSTAT is quick and easy to install . . . no special tools are required. You can ship ducts nested together and store them outside on the job site.

Apply Anywhere

AIRCOUSTAT eliminates noise in a wide range of applications: general and private offices, conference rooms, sleeping quarters, and recording studios.

Born of the Jet Age

Koppers' amazing new AIRCOUSTAT is the product of years of experience in designing sound control installations for aviation and other industries. Jet engine housings, machine enclosures, sound barriers and traps, sound-proof foremen's offices—these are only a few of the many sound control devices created by Koppers Industrial Sound Control engineers. Koppers has put this engineering "know-how" to work silencing air conditioning noises more effectively . . . more economically than was ever before possible . . . saving you time and costs.

For more details, write to KOPPERS COMPANY, INC., Industrial Sound Control Dept., 6308 Scott Street, Baltimore 3, Maryland.

*Koppers Trademark

KOPPERS

INDUSTRIAL SOUND CONTROL

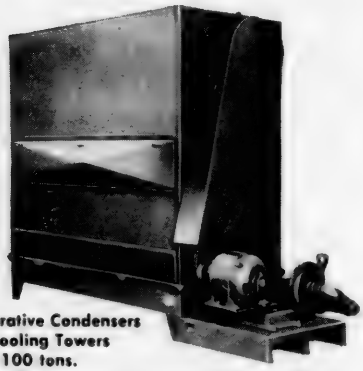
Engineered Products Sold with *Service*

3 FACTUAL reasons *why* Curtis *dealers can make more money— CONSISTENTLY:*

1 CURTIS has 102 years of experience in manufacturing precision made equipment. One of the first manufacturers of packaged air conditioning units—since 1936.

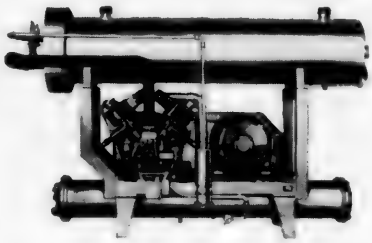
2 Unsurpassed know-how for building air conditioning units that operate longer with less maintenance and service—YET ARE COMPETITIVELY PRICED with generous profit margin for you.

3 CURTIS provides sales and promotional aids—a complete financing plan—and a national advertising campaign to make your selling easier.

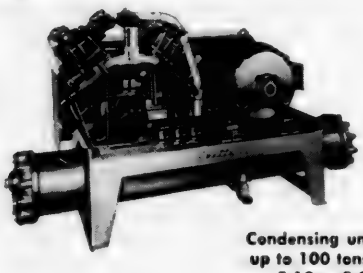


Evaporative Condensers and Cooling Towers up to 100 tons. Air handling units to match.

Packaged units in a rainbow of colors— a CURTIS exclusive. 3 through 50 tons.



Packaged Liquid Chillers— 7½ to 100 tons—F-12 or F-22. With room console units to provide controlled cooling and heating without duct work.



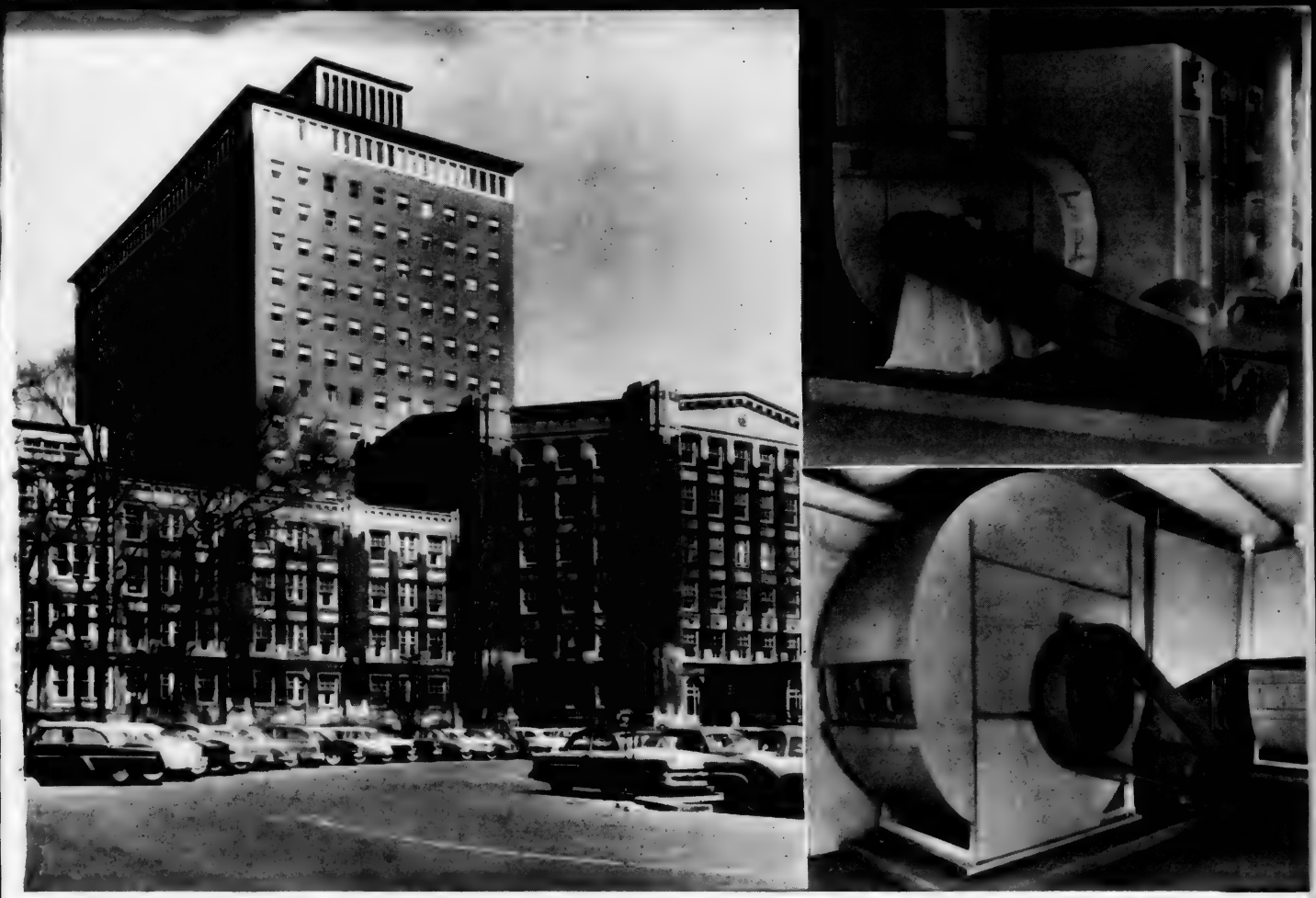
Condensing units up to 100 tons— F-12 or F-22.

Packaged Air Cooled Air Conditioning Units— 2 through 7½ tons. Residential and Commercial applications.

Remember **YOU CAN COUNT ON** **Curtis**

MANUFACTURING COMPANY

REFRIGERATION DIVISION • 1999 Kienlen Ave., St. Louis 20, Mo.



Top Left — New Henry Ford Hospital Clinic, Detroit, Michigan. Voorhies, Walker, Smith & Smith, Architect-Engineers; R. L. Spitzley Company, Mechanical Contractors; George A. Fuller Company, General Contractors. Top Right — 4 "Buffalo" Heavy-Duty Fans handle air up to 6" SP for Carrier Corp. Weather-master System using modern high-pressure conduit distribution. Bottom Right — One of 54 Type BL Limit-Load (r) Ventilating Fans delivering from 3700 cfm at 1¾" to 30,000 cfm at ⅝" SP quietly and efficiently at Henry Ford Clinic.

OVER 100 "BUFFALO" AIR HANDLING UNITS HELP PROVIDE HOSPITAL-QUIET SERVICE AT HENRY FORD HOSPITAL CLINIC

Besides reliability, a major requirement of hospital air handling equipment is minimum noise level. This fine new Henry Ford Hospital Clinic enjoys this quiet, vibration-free operation in its "Buffalo" Fans and Air Conditioning Units, even with large installations concentrated on the 2nd, 5th and 17th floors.

In addition to the BL Fans mentioned above, this includes "Buffalo" Vent Sets, Spray Coil Dehumidifiers and Air Conditioning Cabinets, Lowboy Unit Heaters, Shortboy Ventilators, and a large number of Aerofin Heating and chilled water coils.

For your next job, specify "Buffalo", the air equipment with the "Q" Factor* that's been meeting the highest requirements of important users since 1877.

**The "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

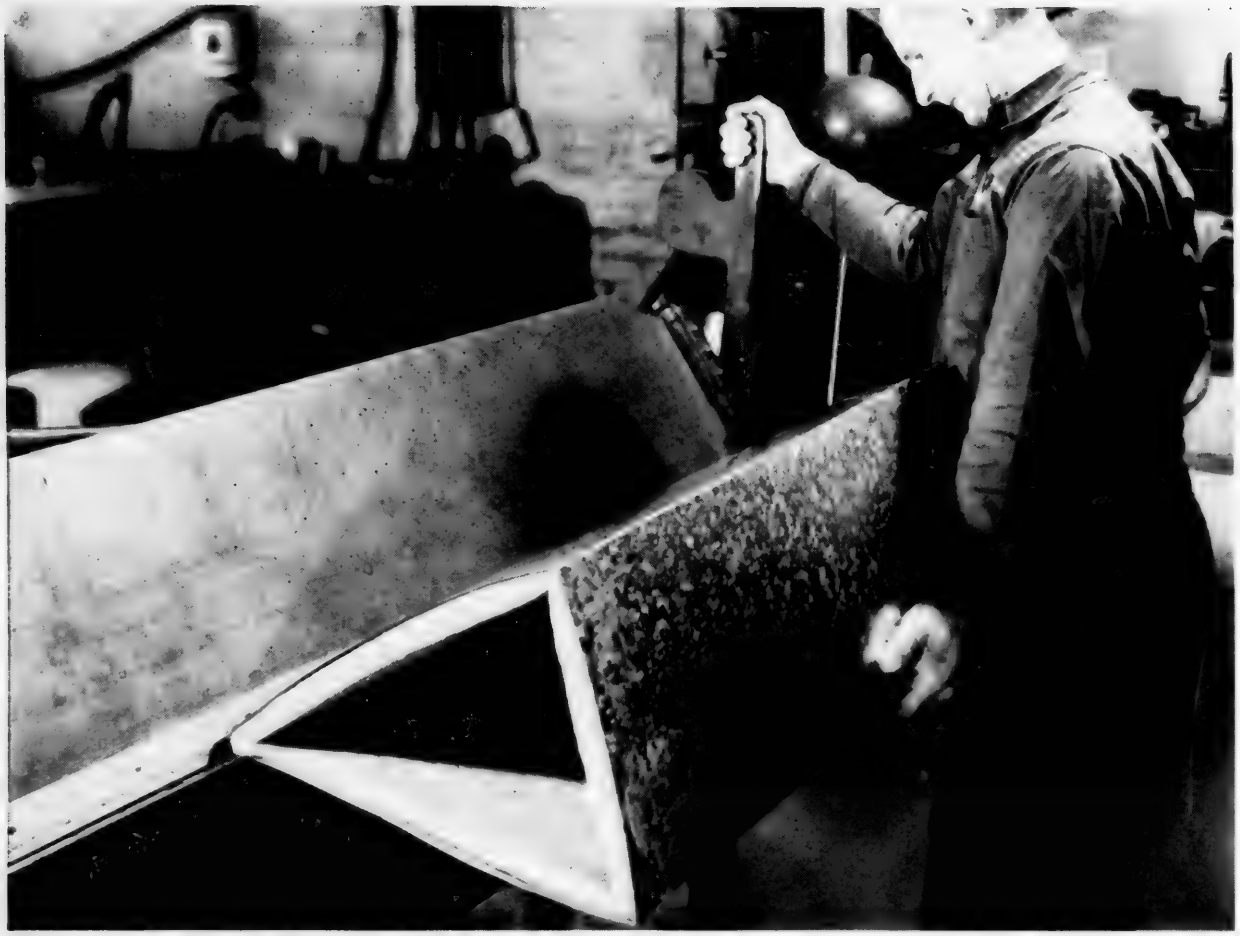
BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

INSULATION news from L·O·F GLASS FIBERS COMPANY



A single piece of L·O·F Glass Fibers' Duct Liner can be cemented to metal and formed in the brake!

Right from the roll to the duct!

Unlike old-fashioned, rigid insulation, L·O·F Glass Fibers' Microlite and Super·Fine blanket insulations are resilient and flexible. They handle pleasantly, without "kid glove" treatment! Easily cut with ordinary knife! Quickly installed—without special tools or skills—L·O·F Glass Fibers' Duct Liner requires no precision cutting or fitting . . . works easily into irregular parts such as elbows. Your costs are kept to a minimum.

The extremely fine glass fibers in Microlite and Super·Fine form millions of tiny dead air cells. For this reason, they are exceptionally efficient acoustical and thermal insulations! Look at all the other important advantages . . .

- *High tensile strength* . . . easy to use, reduce danger of tearing!
- *Compactly packaged in standard widths* . . . compressed to take up a minimum of storage space, yet spring back to original thickness when unrolled.
- *Lightweight* . . . liner adds an insignificant amount of weight!
- *Fire-resistant* . . . glass fibers do not support combustion!
- *Permanent* . . . will not rot!

Neoprene- or vinyl-coated Microlite and Super·Fine are recommended for normal and high velocities . . . uncoated liner may be used for lower velocities. For complete information, contact your nearest distributor; or write *L·O·F Glass Fibers Company, Dept. 63-86, 1810 Madison Avenue, Toledo 1, Ohio.*

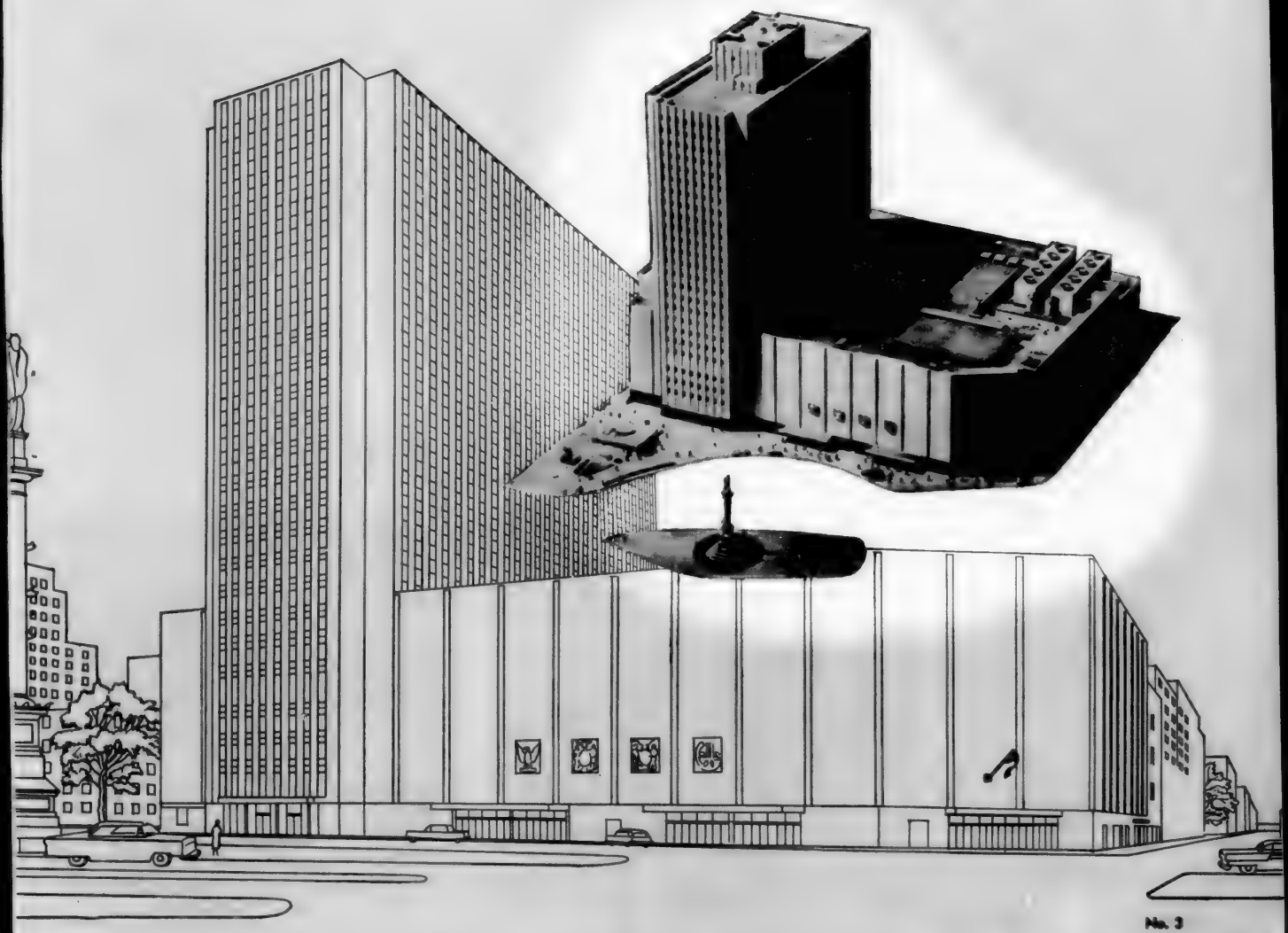
MICROLITE
LOF GLASS FIBERS
SUPER·FINE

L·O·F GLASS FIBERS COMPANY

TOLEDO 1, OHIO

Makers of glass fibers by the exclusive "Electronic-Extrusion" process

Tuttle + Bailey equipment installed
to handle air distribution requirements
in New York's fabulous "showplace of shows"



No. 3

Providing year-round air-conditioned

ARCHITECT — Eben and Lionel Levy
MECHANICAL ENGINEER — Guy B. Panero
GENERAL CONTRACTOR — Walsh-Fuller-Slattery
AIR CONDITIONING, HEATING AND VENTILATING CONTRACTOR — Alstrall & Co., Inc.

(A) Progress photo in 20-story office tower.

(B) Lobby entrance of office tower.

comfort in New York Coliseum posed unusual mechanical problems

. . . solved with an integrated high and low pressure system utilizing Tuttle & Bailey air distribution equipment.

A In the 20-story office tower, a high pressure double duct system extends up through two vertical shafts. Two Tuttle & Bailey temperature mixing units on each floor supply blended proportions of heated and cooled air to Tuttle & Bailey sound attenuation units located in the suspended ceiling. Structurally, this unique system minimized the duct space required above the ceiling. Performance-wise, it provides two interior zones on each floor to meet varying temperature requirements of tenants.

B In the striking lobby entrance of the office tower, low pressure Tuttle & Bailey diffusers blend with the lighting motif.

C In the entire length of the impressive 300 ft. lobby entrance to the main exhibition hall, Tuttle & Bailey low pressure supply and return grilles are installed on alternate sides of the square luminous lighting modules.

D Throughout the mezzanine exhibition areas, 8 ft. lighting modules are set into a waffle-type slab ceiling. Tuttle & Bailey high pressure sound attenuation units are located in the center of each module. High pressure ducts formed in the slab ceiling are connected with main supply ducts at the building perimeter, resulting in a zone control single duct type of system.

E The dramatic, spacious main exhibition area is conditioned from a height of 65 ft. with Tuttle & Bailey diffusers located in the vast structural network.

If you have a specific air distribution problem involving a low or high pressure system, Tuttle & Bailey's Engineering Department will welcome the opportunity to be of help. Address: R. D. Tutt, Chief Engineer, Tuttle & Bailey, New Britain, Connecticut.

TUTTLE & BAILEY

division of Allied Thermal Corp. New Britain, Connecticut

C Lobby entrance of exhibition hall.

D Portion of mezzanine exhibition area.

E Main exhibition area.

Random Thoughts from a Filter Engineer

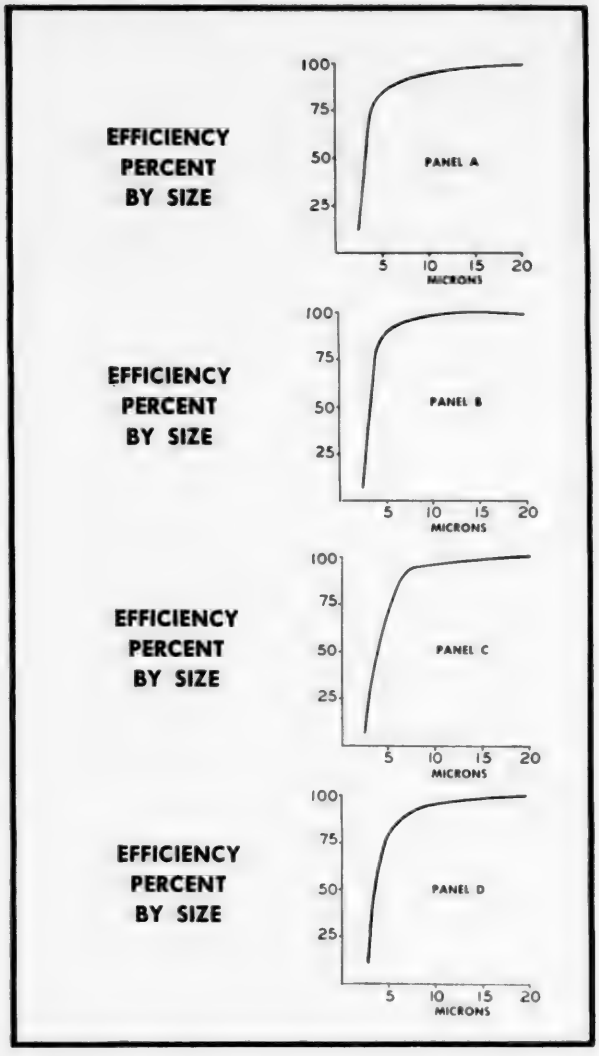
by A. F. Siers, Sales Engineer

- **AIR FILTER EFFICIENCY GRAPHS CAN BE CONFUSING**
- **THE CASE OF THE DISGRUNTLED BANK PRESIDENT**

AIR FILTER EFFICIENCY GRAPHS CAN BE CONFUSING ... EVEN TO ENGINEERS

Every once in a while, we lose a filter order because a competitor has come up with a new method of presenting performance figures.

Take particle size analysis, for example. We have never believed that a viscous impingement filter was indicated for small particle removal. To satisfy ourselves and some of our customers, we decided to check a few different filters on this basis.



The graphs tell the story well. We selected four different filter panels—three of them competitive units. Each was subjected to the same carefully controlled conditions. Same adhesive application, same dust, same rate of feed, same air flow, same test method. Samples of the effluent air were taken on Millipore samplers and the contaminant microscopically analyzed.

The results show that while a particle size determination may be useful in evaluating generic *types* of filters, it has little value in comparing one filter with another.

To date, we've found no better way to give you filter test data than the procedure adopted by the Air Filter Institute. If all filter manufacturers adopt this test method, much of the confusion now existent in test data would be eliminated.

THE CASE OF THE DISGRUNTLED BANK PRESIDENT

The who-dunnit detectives have nothing on us. We're frequently called in to solve filtration mysteries baffling as any the "private-eyes" work on. What we call the "Case of the Disgruntled Bank President" is a good example.

A certain bank recently installed one of our Electromaze electronic filters. They insisted on the most efficient air filtration. The Electromaze filled the bill because it removes dirt particles down to 1/50 of a micron. Imagine the dark thoughts that passed through the bank president's mind when one fine morning, he found his desk covered with a fine layer of dust. You're right, telephone wires hummed. Within the hour our men were going over the installation with a fine tooth comb. The electronic tubes were in top shape, the ionizing wires fine—in fact the entire installation was in apple-pie order. Finally we found the culprit. One of the bank's maintenance men had switched off the current in the mistaken belief that he could save himself some work!

Of course this is a more whimsical case than the run-of-the-mill air filtration problems we're called upon to solve. We think though it illustrates one important advantage of Air-Maze equipment . . . sure, fast service, the unseen part of our products. Service like this is as near as your telephone. Trained representatives in 83 cities are ready to give you friendly, competent help . . . whenever and wherever you need it.

AFI MEMBER AIR FILTER INSTITUTE

AIR-MAZE
The Filter Engineers
AIR FILTERS • SILENCERS • SPARK ARRESTERS
LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

Cleaner air with half the filters

—reports large metropolitan library

Keeping hundreds of thousands of library volumes as dirt- and must-free as possible calls for quantities of clean, fresh air.

At one large library, they tried many types of filters —were using banks of two 1″-thick throwaway filters in series—to clean intake air. But the surfaces quickly clogged with dirt—operating costs became excessive. Then they tried PLIOTRON — the world's first truly washable, electrostatic, panel-type air filter.

They soon found single banks of PLIOTRON, 1″ thick —*only half the number*—cleaned the air better, did not clog and were easily cleaned for repeated use. That's because the unique filter medium of PLIOTRON carries a permanent, electrostatic charge that actually attracts and captures up to five times as many fine dirt particles. It also permits depth-loading rather than surface-loading, and maintenance of full efficiency by simple washing.

PLIOTRON can bring cleaner air at lower cost and with less work to any forced-air heating or air-conditioning system using panel filters. For details see your PLIOTRON Distributor. Or write Goodyear, Pliotron Sales Dept. 722, Akron 16, Ohio.

PLIOTRON Air Cleaner by

GOODYEAR

Pliotron—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

THE GREATEST NAME IN RUBBER

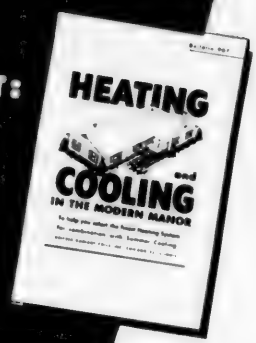
NOW

KRITZER

heating and cooling equipment

QUALITY — *PROFIT!*

SEND FOR THIS FREE ILLUSTRATED BOOKLET:



ASK YOUR JOBBER FOR KRITZER PRODUCTS

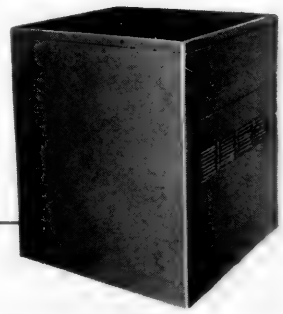
"IF IT'S KRITZER, IT'S RIGHT, SIR!"

DUAL-VECTOR®

Low cost, combination heating and cooling units for residences, apartments and motels. Two models fit between studding. Easy installation. Clean, filtered air both summer and winter. Insulated enclosures prevent condensation. Individual room control optional. Free-standing types for remodeling.

HYDRO-PAC® WATER CHILLERS

Completely packaged. Factory tested. Ready for easy field installation. Fine "furniture" steel cabinets with baked enamel finish. Five year warranty on hermetic system.

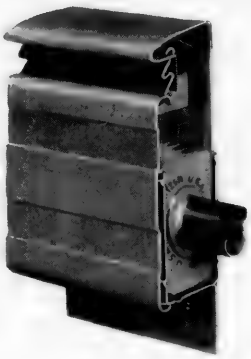


UNIT HEATERS

Horizontal and vertical discharge, propeller fan types. Wide selection of sizes for steam and hot water. Die formed cabinets of heavy gauge steel. Baked-on, gray hammer enamel finish. Rubber mounted motors. Dynamically balanced fans in deep drawn venturi for quiet operation.

CONVECTOR-RADIATORS

Floor, wall hung and recessed models. Famous KRITZER coil construction for steam and hot water. Bronze headers. Heavy, reinforced steel cabinets. Full range of sizes. Chain or knob operated dampers. Cabinets phosphatized. Gray prime baked-on finish.

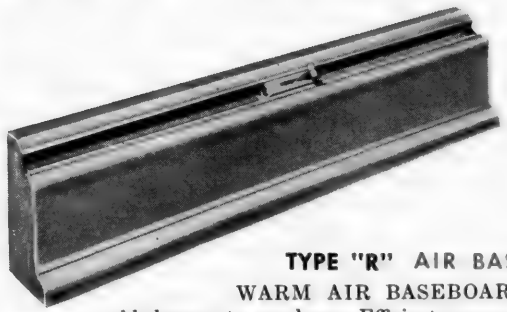


"K" LINE RADIANT BASEBOARD

Clean, modern lines. Quiet. Easy to install. For homes, apartments, offices.

STB RADIANT BASEBOARD

For hard-to-heat areas. Large heating capacity. Safe, rounded edges and corners.



TYPE "R" AIR BASE
WARM AIR BASEBOARD

adds beauty to any home. Efficient warm air heating or cooling. Two and four foot lengths. Built to last.

KRITZER RADIANT COILS, INC.
2901 Lawrence Ave. • Chicago 25

KRITZER

"As an engineer, I insist on the GUARANTEED EFFICIENCY of Packaged Boilers"

"Boiler efficiency used to be an X factor – an unknown gamble where the odds were stacked against the buyer. No engineer likes to gamble, so we used to recommend oversize boilers, just to play it safe.

"Then, to answer a major industrial need, the Packaged Boiler was developed. With its *guaranteed efficiency* of 80%, it eliminates all our guesswork. Now we can specify exactly the right size boiler for every job. When plant expansion calls for greater steam production, additional Packaged Boilers can be added – easily, economically, conveniently.

"Packaged Boiler efficiency doesn't fluctuate, either. It stays almost constant throughout a wide load range . . . and throughout the long life of the boiler."

Six Reasons Why it Pays to Buy a

CONTINENTAL

Automatic Boiler

* Guaranteed 80% efficiency . . . Fire-tested before shipment . . . Range, 20 to 500 hp.
* Simple, practical two-pass design, for uniform flow of combustion gases through all return tubes.
* Maximum radiant heat transfer achieved by "Spinning Gas" technique for thorough mixing of air and atomized fuel.
* High-CO_2 and low-temperature stack gases — proof of high combustion efficiency.
* Free, rapid water circulation improves heat transfer, keeps heating surfaces clean.
* Easy access to furnace and all return tubes. Refractory baffles and brickwork are not required.

For details on the Continental Automatic Boiler, send for Bulletin BE-3

BOILER ENGINEERING & SUPPLY COMPANY, INC.

7 Manavon Street, Phoenixville, Pa.

A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

The Continental AUTOMATIC BOILER

This pump puts maintenance men on the shelf

The maintenance man who depends on repairing Dunham Vacuum Heating Pumps for his living . . . can quit right now. There's nothing for him to do.

Dunham Code Rated Pumps just don't *require* extensive maintenance—even after 15-20 years of continuous service producing high vacuum (26 in., if required) at low amperage. Here's why:

Dunham Pumps need no close clearance adjustment to maintain capacity . . . no extra-high air capacities to compensate for lower efficiency due to pump wear.

Dunham Pumps have *only one* principal moving part.

Dunham Pumps need *only one* motor for removal of *both* air and condensate.

Dunham Pumps have no vacuum on pump stuffing box.

Dunham Pumps are code rated—your assurance of more than adequate air capacity, without overrating to compensate for leaky systems.

Dunham Pumps have heavy-gauge copper bearing steel tanks for maximum resistance to corrosion.

Single and duplex models in capacities from 2500 through 65,000 EDR. For full information, mail coupon.

DUNHAM® HEATING & COOLING EQUIPMENT

RADIATION • CONTROLS • UNIT HEATERS • PUMPS • SPECIALTIES

C. A. DUNHAM COMPANY • CHICAGO • TORONTO • LONDON

C. A. DUNHAM COMPANY
Dept. ACHV-8, 400 W. Madison Street
Chicago 6, Illinois

Please send me Vacuum Pump literature.

Name_____

Firm_____

Address_____

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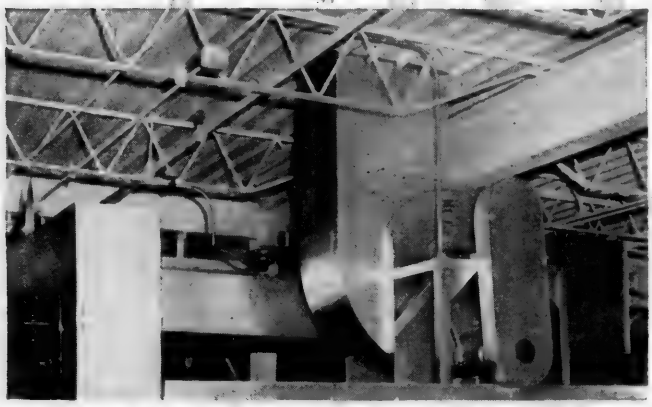
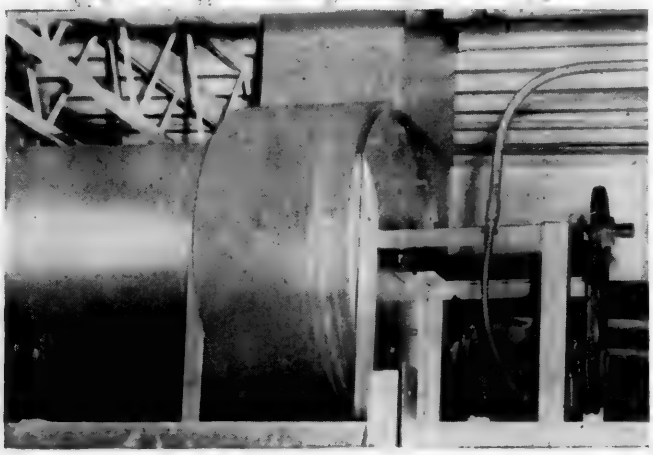




Heat and Fumes

don't faze these *Specially Engineered* Peerless Blowers!

• Top picture: Peerless 222G Backward Curve Blower exhausts hot air from paint baking oven. Center picture: Peerless 135K Blower circulates hot air in paint drying oven. Bottom picture: Peerless 270L Blower exhausts fumes from paint drying oven. Another Peerless 165F Blower (not shown) in same plant forces hot air into paint baking oven. Operating temperatures: Between 300° to 500° F.

• These four specially-designed and engineered Peerless Blowers operate quietly and efficiently in the finishing department of one of the nation's most modern production plants. They were designed for economical, dependable performance in extreme heat. We can do the same for you. Installations like this are our specialty. Contact us today!

Write, Wire or Phone for Bulletin SDA-160 Today!

FAN AND BLOWER DIVISION

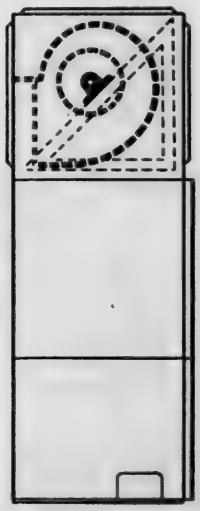
THE *Peerless-Electric*® COMPANY

FANS · BLOWERS · ELECTRIC MOTORS · ELECTRONIC EQUIPMENT

1400 W. MARKET ST. WARREN, OHIO

Here's an Economical and Efficient Improvement

for Air Conditioning Equipment . . .



FEATURES

Two-piece, pressed steel housing . . . occupies less space than similar pillow block housings.

Precision ball bearing, Fafnir Extended Inner Ring Type, offers extra wide bearing surface on shaft. Balls and races are finished for super-quiet performance.

Self-locking bearing collar of counterbored, mated-cam construction. Needs no lock washers, adapters, or other positioning devices.

Plya-Seals provide positive retention of lubricant and complete protection against contaminants. Special lubricant pre-packed at factory contributes to quietness of operation.

Thick, electric-current-conducting rubber interliner eliminates the need for metallic grounding springs or clips.

Six-page bulletin on all Fafnir Air Conditioning Units provides detailed information including dimensions and load ratings.

Specifically designed for air conditioning units with fan shafts up to an inch in diameter, the Fafnir RPB Type Ball Bearing Pillow Block offers an inexpensive way to improve performance, increase sales appeal. It has been adopted as standard equipment by several manufacturers. Actual installations are demonstrating its advantages.

Next to super-quiet, trouble-free performance, manufacturers are most impressed with the easy installation of RPB units. The bearing slip-fits onto shaft and is positively locked to it by a quarter turn of the famous Fafnir self-locking collar. The housing is installed with two bolts. It affords unrestricted initial alignment in all directions. For more information on the RPB unit and other Fafnir super-quiet ball bearing units designed specifically for air conditioning and heating equipment, write The Fafnir Bearing Company, New Britain, Connecticut.

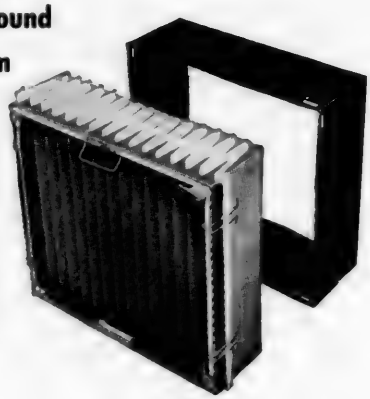
FAFNIR

BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

CLEAN AIR by AAF in Denver's Mile High Center

Airmat PL-24 Filters Supply 350,000 cfm on Year-round Air Conditioning System



Denver's Mile High Center. Architects: I. M. Pei & Associates; Kahn & Jacobs and G. Meredith Musick; Consulting Engineers: Jaros, Baum & Bolles; Severud-Elstad-Krueger.

Even Denver's famous clean, dry air wasn't good enough for the builders of the city's new Mile High Center. They proved that high style, public plazas, fountain-pools and year-round air conditioning (featuring *clean air)* add up to a good, sound, long-term business investment.

The Airmat PL-24 was selected from AAF's complete air filter line to do the important air cleaning job. It's the world's most efficient mechanical filter for ventilating and air conditioning service. It packs 28½ square feet of filtering area into a compact 2′ x 2′ x 8″ unit . . . . features low-cost renewable media and unit construction for simplified maintenance.

The unique design of the Center challenges accepted office building standards, but the reliance on Airmat PL-24 is nothing new. More than a *quarter-million* PL-24 units are now supplying business and industry with more than *300 million cfm* of clean air. For complete product information, call your nearest AAF representative or write direct for Bulletin 230.

AAF Dust Control Equipment

Illinois Steam Heating Specialties

AAF herman nelson

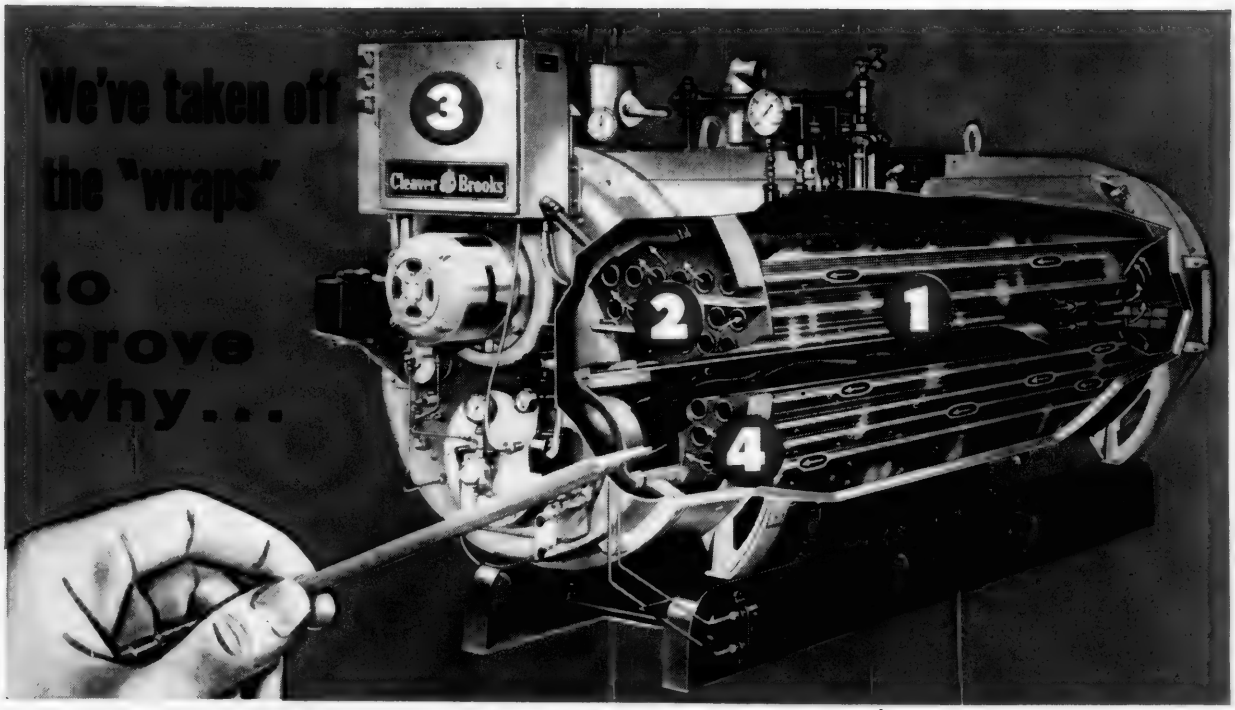
American Air Filter COMPANY, INC.

294 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

BETTER AIR IS OUR BUSINESS

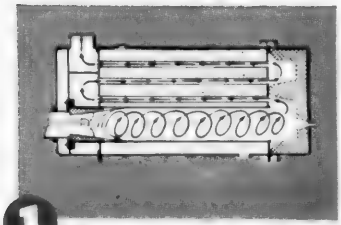
Herman Nelson Unit Heaters

Herman Nelson Unit Ventilators

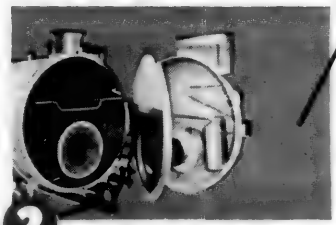


CB is America's most modern boiler

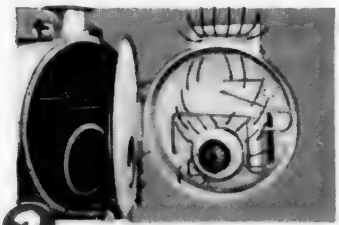
unmatched in performance quiet operation low-maintenance



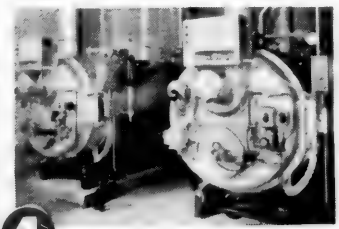
1 **Four-pass design with forced draft** — Proved the most efficient combination to transmit greatest percentage of heat to boiler water. Blower provides cool, clean air in required density and volume for efficient fuel combustion — lowers fuel costs.



2 **Hinged doors front and rear** — Expose tubes for quick inspection or cleaning. Operating equipment and refractory stays intact. Cuts routine maintenance from hours to minutes. Doors are gasketed with preformed asbestos to be seal-tight.



3 **Caseless fan keeps operation "hospital quiet"** — Air is drawn into a large plenum chamber which confines and deadens air noises. Even at peak loads, CB is well within requirements for low sound levels where this is a factor.



4 **Automatic controls are centralized for convenience, efficiency and safety** — Air is metered with oil (or gas) in proper ratios to economize on fuel. Electronic flame failure control is standard equipment.

CB boiler's remarkable performance in hundreds of applications has proved an "eye-opener" wherever installed. Take a minute's time and see why.

Combined into one boiler package are all the features *proved necessary* to: (1) save fuel dollars, (2) simplify maintenance, (3) assure silent performance, (4) maintain safe, automatic operation.

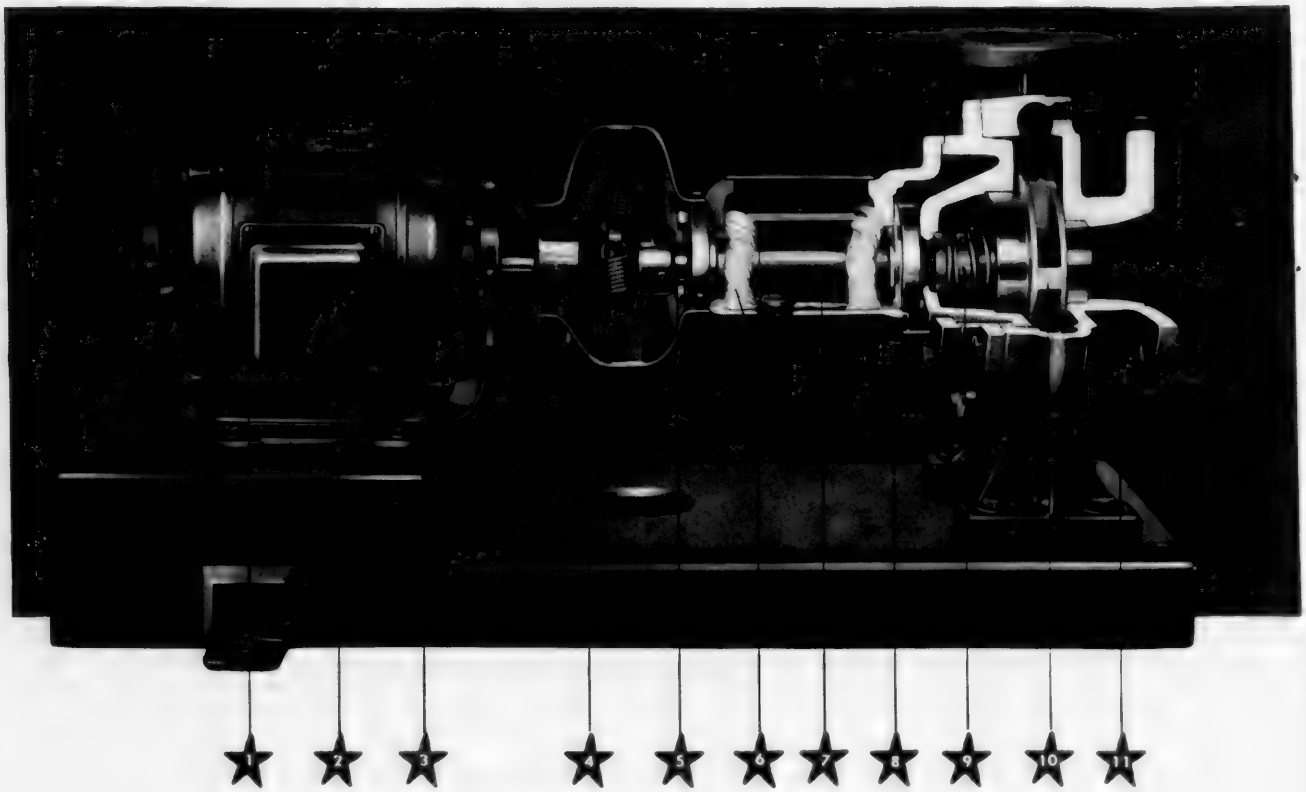
Talk to your nearby Cleaver-Brooks boiler representative — he can assist you in selecting the proper unit from a complete line of sizes, steam or hot water, 15 to 250 psi. Or, write direct for literature. Cleaver-Brooks Company, Dept. J, 383 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CEEBEEWEST — all codes.

BOILERS—STEAM OR HOT WATER—FOR HEATING OR PROCESSING, IN SIZES 15 TO 600 HP, 15 TO 250 PSI.

Cleaver Brooks

TWENTY-FIVE YEARS OF LEADERSHIP
BY THE ORIGINATORS OF THE SELF-CONTAINED BOILER

WHY B & G UNIVERSAL PUMPS



DESIGNED SPECIFICALLY FOR *QUIET* OPERATION IN LIQUID HEATING AND COOLING SYSTEMS

The circulating pump in a hot water heating or chilled water cooling system is the connecting link between the mechanical equipment in the boiler room and the structure itself. *Silent*, *vibrationless* operation is therefore the prime requirement in a pump for this type of service. The features starred above are the reasons why the B&G Universal Pump fully meets this need.

THE MOTOR

1. **Extra quiet.** The Universal Pump motor is specially constructed, tested and hand-picked for extra-quiet operation.

2. **Sleeve bearings.** Motors are equipped with oil lubricated bronze sleeve bearings—essential to silent operation and long life.

3. **Mounting.** Universal motors, through 5 HP, are NEMA ring-type mounted and completely suspended in noise-dampening rubber. All motors are drip-proof.

THE PUMP

4. **Coupler.** Self-aligning, spring-type...another warranty of silent operation, plus excellent pump and motor protection against the stresses of starting torque.

5. **Shaft.** Big—oversized—affording large bearing surfaces. Made of special alloy steel, polished to mirror finish. Heat-treated integral thrust collar absorbs end-thrust... lengthens seal and motor bearing life.

6. **Lubrication.** Genuine oil circulating. No grease to channel or harden. Oil level indicator permits visual check.

7. **Sleeve bearings.** An essential for quiet, vibrationless operation and long life of both pump and motor. An outstanding Universal feature.

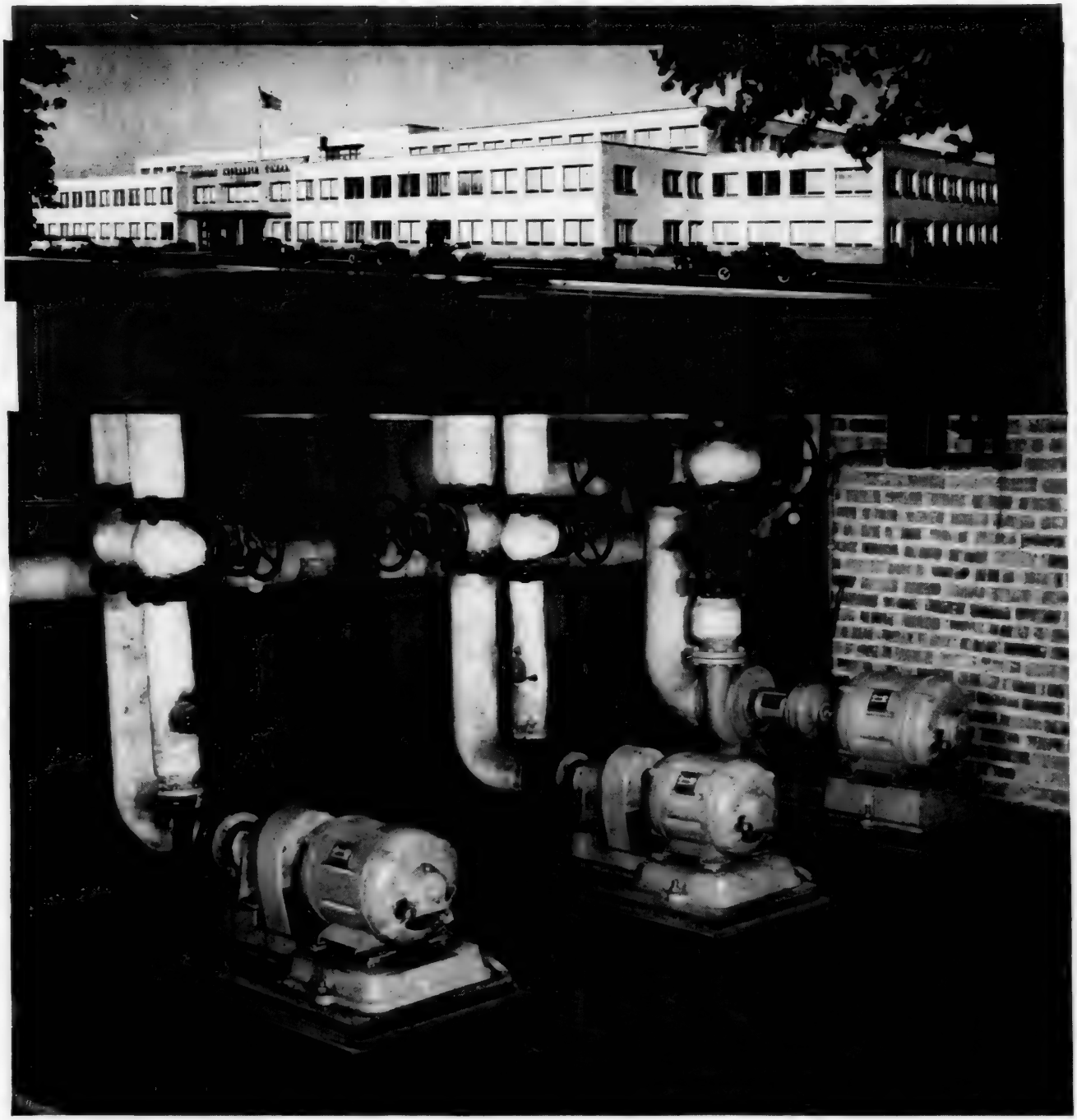
8. **Removable bearing frame for easy servicing.** The entire bearing frame assembly with impeller is easily removed from volute. No pipe connections to break or motor to remove...all the advantages of split case design. All bearing frame assemblies are interchangeable.

9. **Mechanical seal.** Positively prevents water leakage up to full design pressures. The seal is self-lubricating and features a floating seat of diamond-hard "Remite"—a B&G development.

10. **Hydraulically balanced impeller.** Balancing chamber and thrust pressure relief holes in the impeller reduce thrust to a minimum.

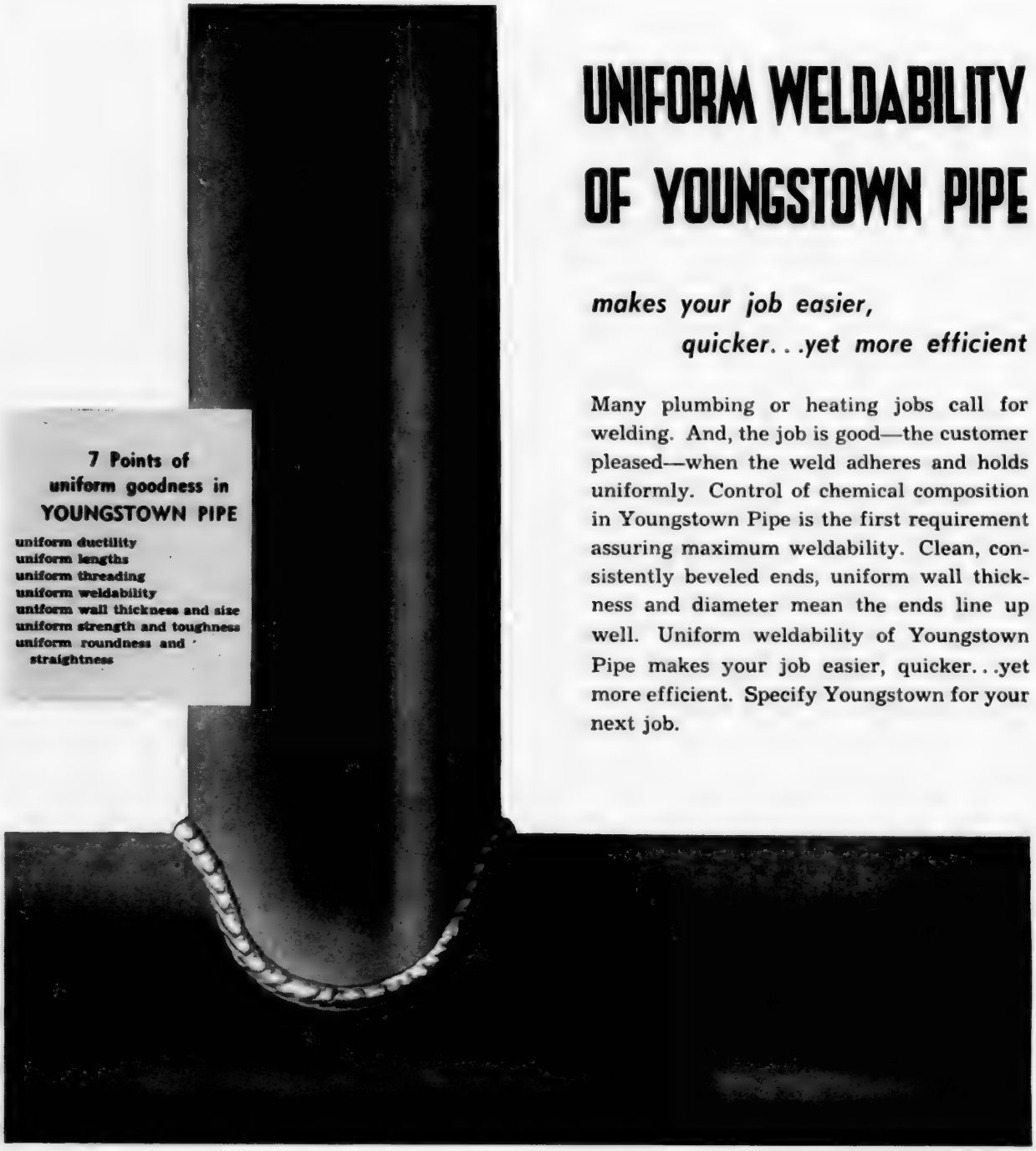
11. **Solid volute.** Support feet directly below volute absorb piping strains without distorting pump alignment.

MEET THE TOUGHEST TEST...*QUIET OPERATION!*



Three B&G Universal Pumps circulate hot water to a split plenum coil system in central fan rooms on the first, second and third floors of the building. The system is also equipped with B&G Flo-Control Valves and Relief Valves.

BELL & GOSSETT
COMPANY
Dept. EL-4, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, W. Toronto



7 Points of uniform goodness in YOUNGSTOWN PIPE

uniform ductility
uniform lengths
uniform threading
uniform weldability
uniform wall thickness and size
uniform strength and toughness
uniform roundness and straightness

UNIFORM WELDABILITY OF YOUNGSTOWN PIPE

makes your job easier, quicker. . .yet more efficient

Many plumbing or heating jobs call for welding. And, the job is good—the customer pleased—when the weld adheres and holds uniformly. Control of chemical composition in Youngstown Pipe is the first requirement assuring maximum weldability. Clean, consistently beveled ends, uniform wall thickness and diameter mean the ends line up well. Uniform weldability of Youngstown Pipe makes your job easier, quicker. . .yet more efficient. Specify Youngstown for your next job.

Youngstown PIPE

QUALITY V YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices Youngstown, Ohio District Sales Offices in Principal Cities

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

If there's a FLOOD in your future

THE BOILER TO BUY IS AN H. B. SMITH

One of the buildings of the Sterling Radiator Company, Westfield, Mass., as it appeared during the flash flood of August 19, 1955.

This is how one of the boilers looked after the flood water subsided.

The northeastern flash floods of August, 1955, left little worth salvaging in their wake. At the Sterling Radiator Company, Westfield, Mass., for example, one wing of the steel manufacturing building containing the boilers was torn open, and the welding and paint shops were completely destroyed. *The only reclaimable equipment was the two H. B. Smith cast iron boilers.* Even though forced from their foundations and up-ended by the flood, damage was so slight that they were quickly and easily repaired, and are now back in operation.

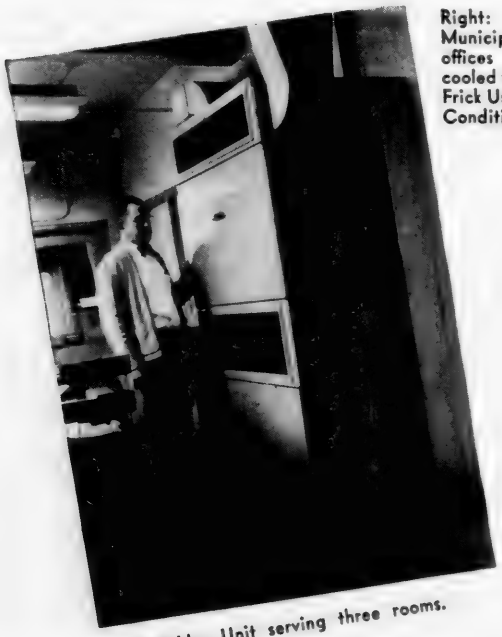
Obviously, there are many attributes other than their amphibious qualities to recommend H. B. Smith cast iron boilers. Consider their prodigiously long life, rapid steaming and high capacity, low maintenance, ease of convertibility from the use of one fuel to another, ready expansibility and economy of operation. These are a few of the reasons why an H. B. Smith cast iron boiler should be first choice for your building, whether or not a flood is to be listed among your operational hazards during the next 50 to 60 years.

The H. B. Smith No. 44 Mills boiler as it appears on its new foundation.

The Smith-Mills No. 200 boiler was restored within a week after the flood and has been in constant use.

H.B. Smith **CAST IRON BOILERS**

H. B. SMITH CO., INC., WESTFIELD, MASSACHUSETTS • *Established 1853*



5-Hp. Unit serving three rooms.

Right: Municipal offices cooled with Frick Unit Conditioners

TRADE FRICK MARK®

Air Conditioning—

Packaged Units or Central Systems

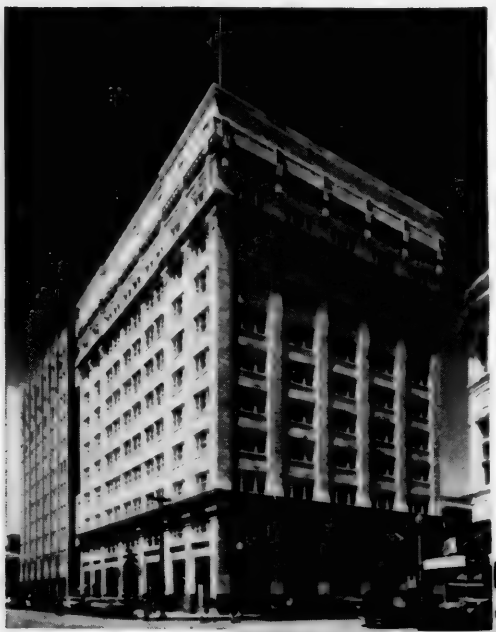
From a 3-hp. unit to a plant requiring thousands of tons of refrigeration is a long step, but they're both included in Frick-engineered air conditioning.

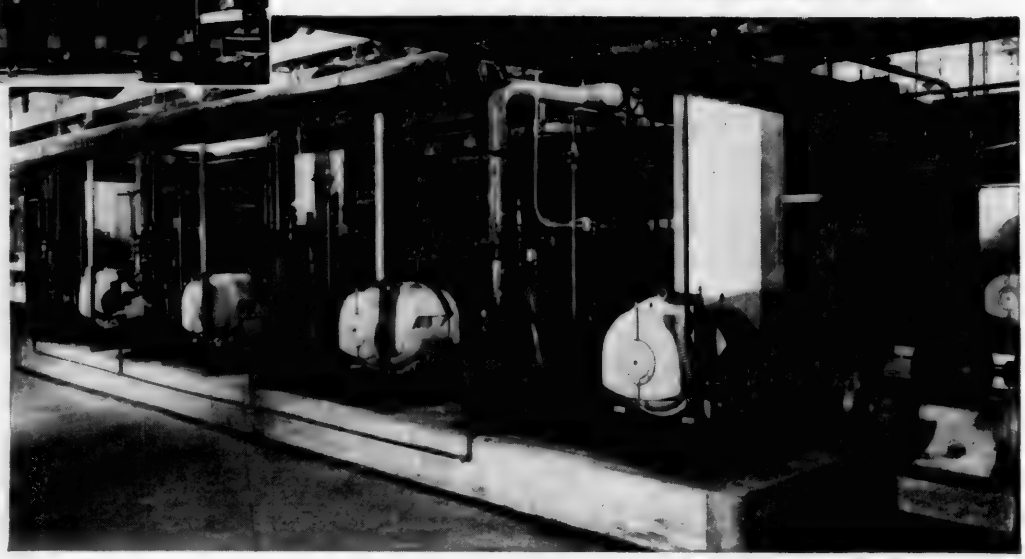
Built into Frick systems are 50 years' experience in air conditioning, nearly 75 in refrigeration, and over 100 in engineering. Nowhere else can you get this unique combination of experience and complete service. Ask for estimates today: write

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.





The two 11-story buildings of the American National Insurance Co., at Galveston, are air conditioned by the multiplicity of 75-hp. "ECLIPSE" compressors shown at right. Thousands of fine buildings are Frick-equipped.

genetron

Super-Dry Refrigerants

Jenni Genetron Says: **"No matter where you are there's a genetron wholesaler near you!"**

genetron 11 ORANGE LABEL
TRICHLOROMONOFLUOROMETHANE

genetron 12 WHITE LABEL
DICHLORODIFLUOROMETHANE

genetron 141 GREEN LABEL
MONOCHLORODIFLUOROMETHANE

genetron 226 PURPLE LABEL
TRICHLOROTRIFLUOROETHANE

genetron 320 DARK BLUE LABEL
DICHLOROTETRAFLUOROETHANE

FREE! Valuable Folder!
Ask your wholesaler for special folder on *Genetron* Super-Dry Refrigerants. Contains pressure-temperature charts and other helpful information.

Coast-to-coast, America's leading Refrigeration and Air Conditioning Wholesalers feature *Genetron* Super-Dry Refrigerants. There's one as near to you as your telephone ready to supply you with complete stocks of *Genetron* Refrigerants and with up-to-the-minute data on their uses.

Remember—*Genetron* Refrigerants are super-dry! Their moisture content is exceptionally low; their overall purity extremely high. They meet the industry's most exacting refrigerant specifications . . . are freely interchangeable with comparable fluorinated hydrocarbon refrigerants produced by any other manufacturer. Follow the industry-wide trend to Super-Dry *Genetron* Refrigerants. Always ask for *Genetron!*

Allied Chemical

GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
Offices in principal cities

©1956, General Chemical Division, Allied Chemical & Dye Corporation

THE WEDGE TAKES THE WEAR - *and spares the rings*

Easy replacement of the wedge only — right on the line — restores full efficiency

THE MONEL SEAT RINGS are expanded into the body to assure a positive, leak-proof joint. Exhaustive tests in typical monel-seated gate valve services show that this permanent all-around support of the rings is essential to guard against deforming, loosening, or shifting.

THE RENEWABLE WEDGE (bronze or nickel alloy) has excellent wear resistance, but has a lower degree of hardness than the heat-treated Monel rings, which have optimum resistance to erosion and corrosion as well as abrasion. Thus, wear of the wedge leaves the rings relatively unaffected. When necessary to renew the wedge, you simply remove the valve bonnet, slip the old wedge off the stem, and slip on a new one.

GET PRACTICAL, LOW-COST RENEWABILITY in the valves you choose for the tough, punishing services that require Monel-seated gates. Compare . . . there is nothing simpler, faster, or more economical than Jenkins replaceable wedge design — and you also get the *plus* of Jenkins *extra value* in every other feature. Jenkins Bros., 100 Park Ave., New York 17, New York.

MADE WITH BRONZE OR NICKEL ALLOY WEDGE

The bronze wedge provides lasting economy for most applications. The nickel alloy wedge provides extra resistance where rapid wear and corrosion are factors.

JENKINS BRONZE GATES WITH MONEL SEAT RINGS

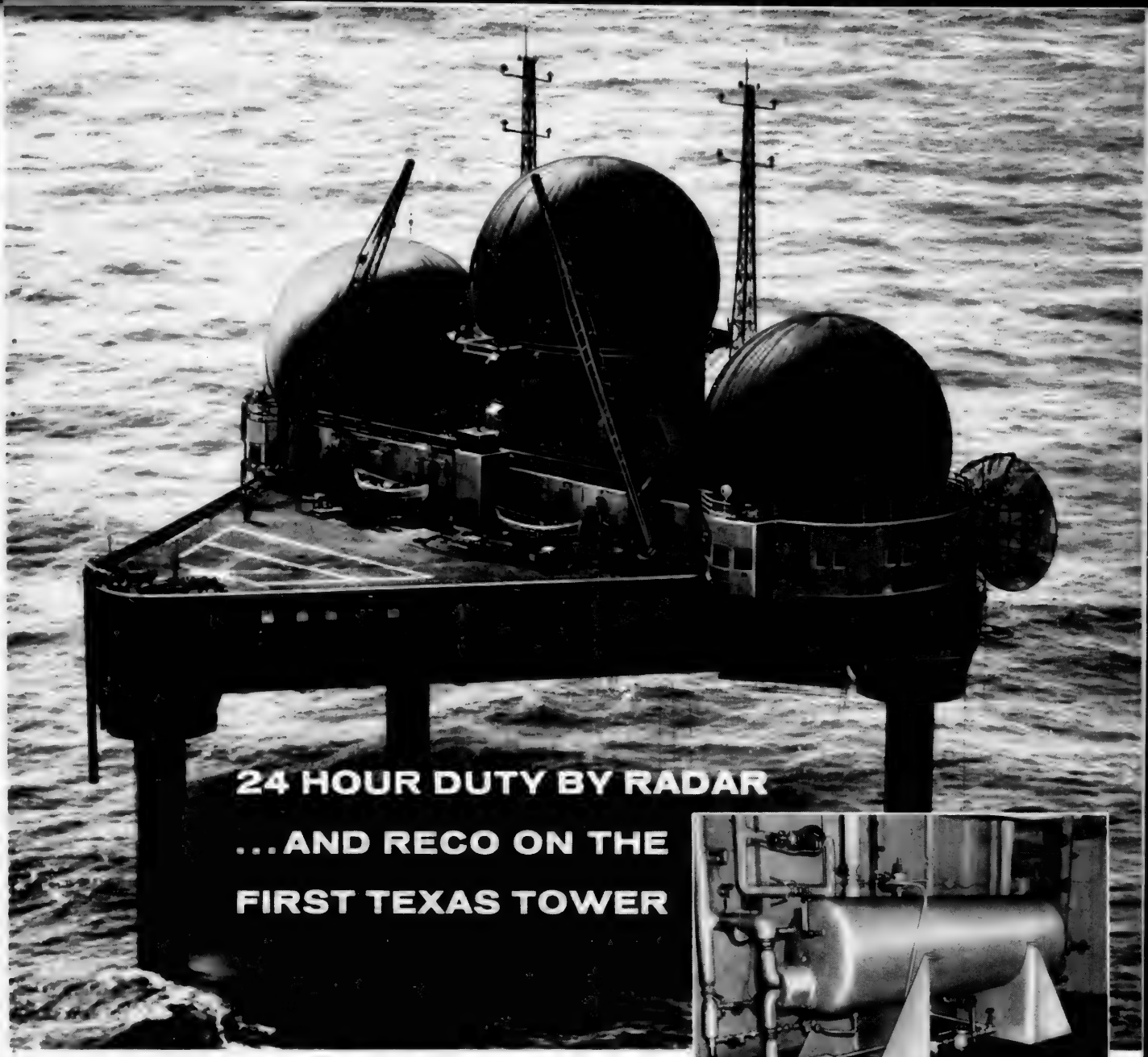
200 psi	300 psi
Fig. 270-U, Bronze Wedge	Fig. 280-U, Bronze Wedge
Fig. 270-UN, Nickel Alloy Wedge	Fig. 280-UN, Nickel Alloy Wedge
Fig. 270-UL, Bronze Wedge, U.L. approved for L.P.G. Services	350 psi Fig. 280-UX, Bronze Wedge

JENKINS BRONZE GATES INCLUDE 40 DIFFERENT PATTERNS

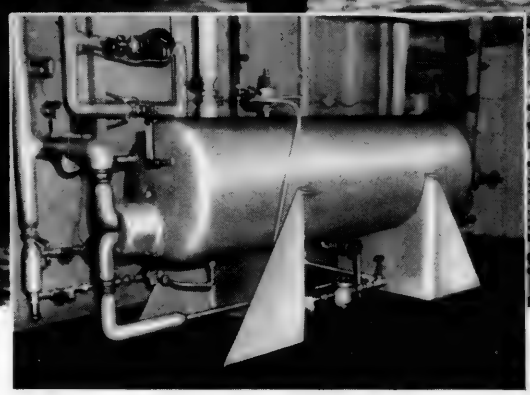
125 • 150 • 200 • 300 • 350 psi SOLID WEDGE • SPLIT WEDGE
SCREWED • FLANGED • SOLDER END • SOCKET END QUICK OPENING

Call your local Jenkins Valve Distributor for complete information.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros



24 HOUR DUTY BY RADAR ...AND RECO ON THE FIRST TEXAS TOWER



U.S.A.F. "Texas" Radar Tower—Architects & Engineers: Anderson-Nichols & Co., Boston—Foundations: Moran, Proctor, Mueser & Rutledge, N.Y.—Contractor: Bethlehem Shipbuilding Co., Quincy, Mass.—Marine Contractor: Raymond-De Long, N.Y.

Somewhere off Cape Cod the first Air Force Radar island, called the Texas Tower, keeps a constant vigil against sneak enemy air attacks. Every piece of equipment on this steel island is on 24-hour duty. There's no let-up in demands. No time for breakdowns. Every item must work at peak efficiency around the clock—around the calendar.

RECO was picked to provide hot water for the tower's fifty man crew. A 30"x108" RECO Hot Water Storage Heater supplies 330 gallons of 140°F hot water per hour—24 hours a day—365 days a year. Galvanized against corrosion, this RECO Hot Water Storage Heater gives top service.

You can have this same round-the-clock reliability with RECO Heat Exchangers. Plus the RECO *guarantee* of top quality, competitive price, and quick delivery.

RECO's full line of Hot Water Storage Heaters, Convertors and Instantaneous Heaters is recommended by leading engineers, contractors and architects throughout the 48 states.

Let RECO fill your hot water needs, too. On your next job—

Richmond Engineering Co., Inc.
Dept. G, 7th & Hospital Sts.
Richmond 5, Virginia—Phone 7-2611

Please send:

- ☐ Free set of Heat Exchanger Catalogs
- ☐ Name of nearest RECO Representative

TO:_____

_____

_____

SPECIFY RECO

"So Airtemp is Chrysler-Engineered— what's that to ME?"

AIRTEMP INSTALLATIONS

STUART INVESTMENT BUILDING
Lincoln, Neb. Contractors: Sidles Company. Built in 1937.

WAVERLY GROWERS CO-OPERATIVE
Waverly, Florida, Contractors: H. N. Webster, Sebring, Fla.

Airtemp
CONSTRUCTION CORPORATION
SUBSIDIARY OF CHRYSLER CORP.

CHRYSLER ENGINEERING MEANS EASIER INSTALLATION AND LESS COST

Installation of Airtemp is simple, easy, trouble-free—because Airtemp is *CHRYSLER-ENGINEERED!* **First,** Chrysler engineering means you specify exactly the type of air conditioning your clients need. **Second,** Chrysler engineering means Airtemp takes up less space, that it is flexible, that it provides individual room air conditioning when needed. **Third,** Chrysler engineering means less installation time and cost.

In short, Chrysler engineering means *peak* performance at *minimum* cost! Whisper-soft operation! Maximum cooling! Minimum maintenance! *All* the factors that spell air conditioning at its efficient best!

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Air Conditioning
FOR EVERY NEED IN HOMES, BUSINESS, INDUSTRY

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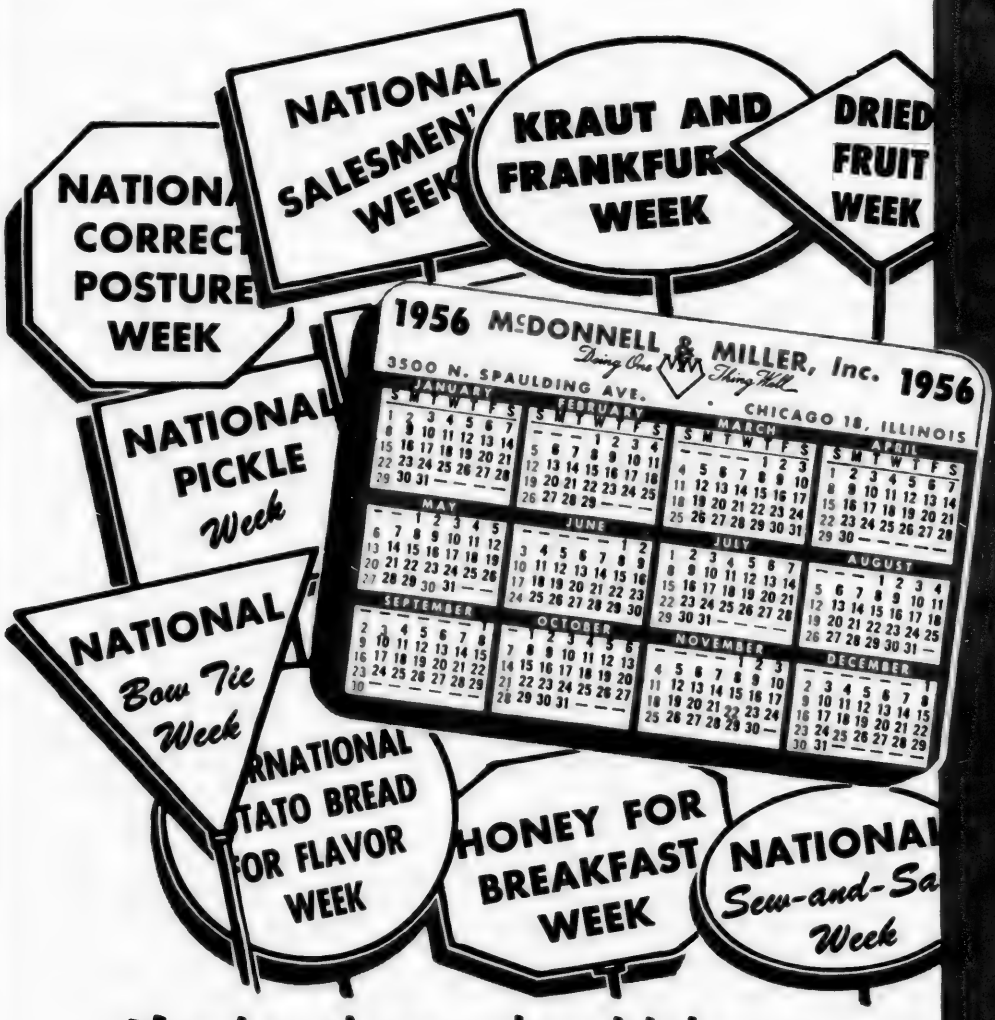


Maybe there should be a "STOP LOW WATER" WEEK!

Certainly the subject of Boiler Safety is as important as Bike Safety, or Fur Care, or Saving the Horse, or some of the others that are recognized by special weeks. And a determined effort to "Stop Low Water" is one big step you can take in the cause of boiler safety.

Boilers are being lost that could be saved by proper precautions against low water. A lot more "accidents" are just waiting to happen. A lot of heating plants are going to give out just when they're needed most.

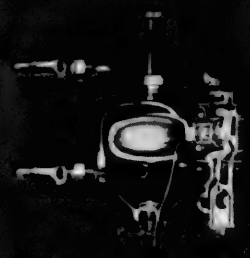
You can't settle the issue in a single week, of course. Low water is a year-round threat; it can strike anytime, from any of dozens of reasons. And it doesn't care where it strikes—hot water heating boilers or steam boilers.

Your best bet is to put every boiler installation in the capable hands of a McDonnell Water Feeder Cut-off Combination . . . the device that stands guard against low water around the clock and around the calendar . . . the device that has been dedicated for more than thirty years to doing this one thing well.

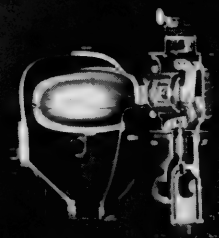
McDONNELL & MILLER, *Inc.*, 3500 N. Spaulding Avenue, Chicago 18, Illinois

Doing One SAFETY CONTROLS *Thing Well*

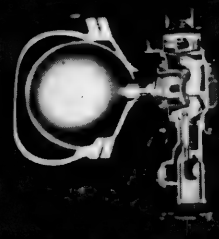
Your Jobber



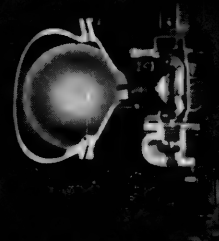
No. 47-2 Feeder Cut-off Combination. The best kind of safety control for the average small steam boiler; maximum pressure, 25 lbs. Has cool feed valve, Quick Hook-up, straight-through blow-off valve and other McDonnell-developed features.



No. 247-2 Feeder Cut-off Combination. Companion to the No. 47-2, developed especially for service on smaller hot water space heating boilers. Maximum pressure, 30 lbs.



No. 51-2 Feeder Cut-off Combination. For larger boilers, both steam and hot water. Maximum pressure, 35 lbs.



No. 53-2 Feeder Cut-off Combination. For higher pressure boilers, up to 75 lbs. Used on both steam and hot water space heating boilers.

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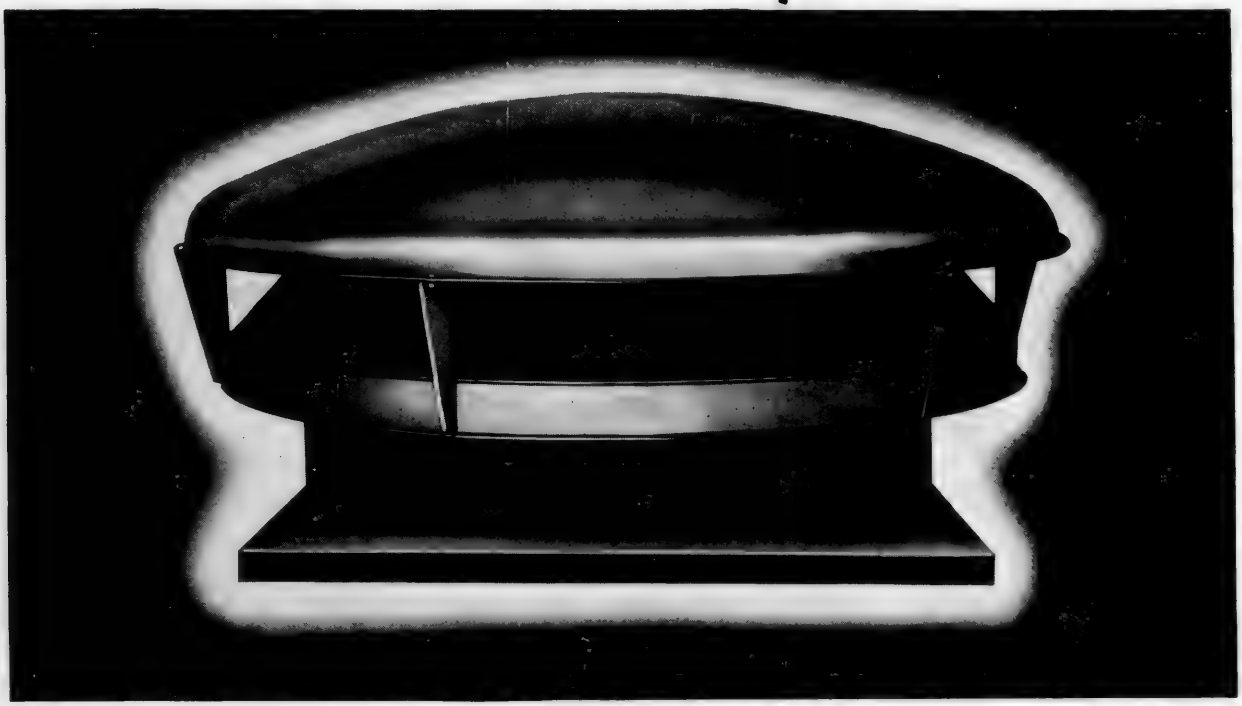

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. . . and with the
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The new *Allen* "I-Line" Roof Fan meets the architect's demand for an attractive unit that hugs the roof without sacrificing the high efficiency required by engineers. This is accomplished by a circular spun hood and fan venturi with a directional baffle so arranged in relation to the propeller as to provide maximum efficiency with minimum over-all height.

In addition, the new "I-Line" design makes installation exceptionally easy and the hinged hood simplifies maintenance and cleaning.

The *Allen* "I-Line" Series Roof Fans are available with *Direct Drive* (400 to 34,000 cfm) or with *Belt Drive* (4,000 to 20,150 cfm).

•

See Sweet's (8b/Al) or write for catalog that gives you specifications and complete performance data.

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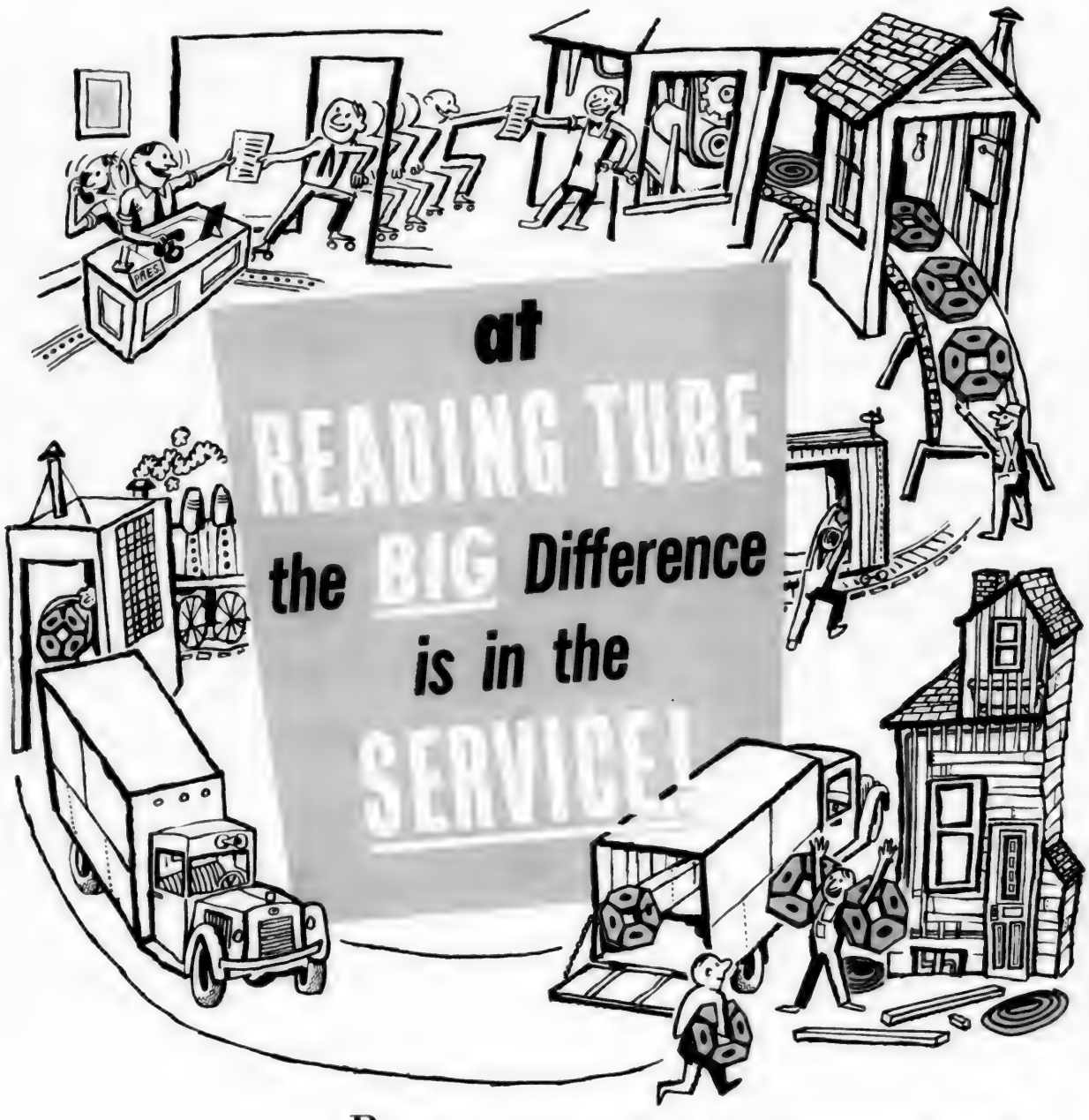

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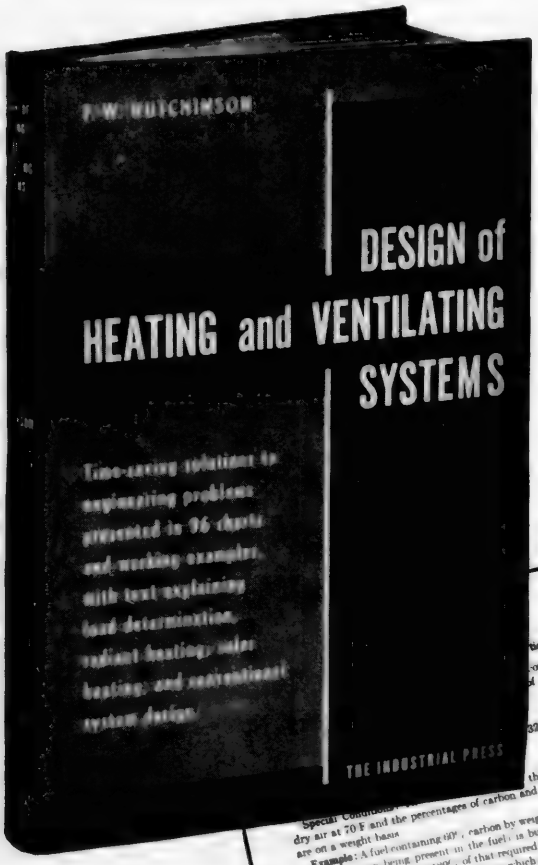
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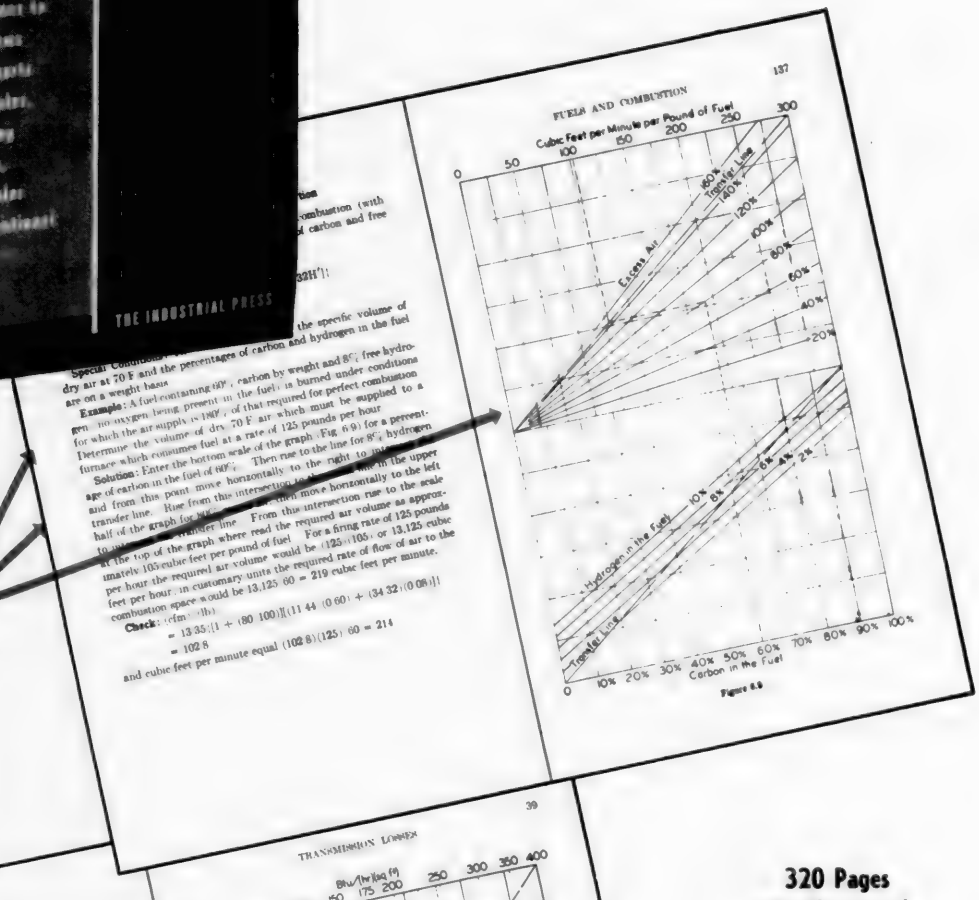

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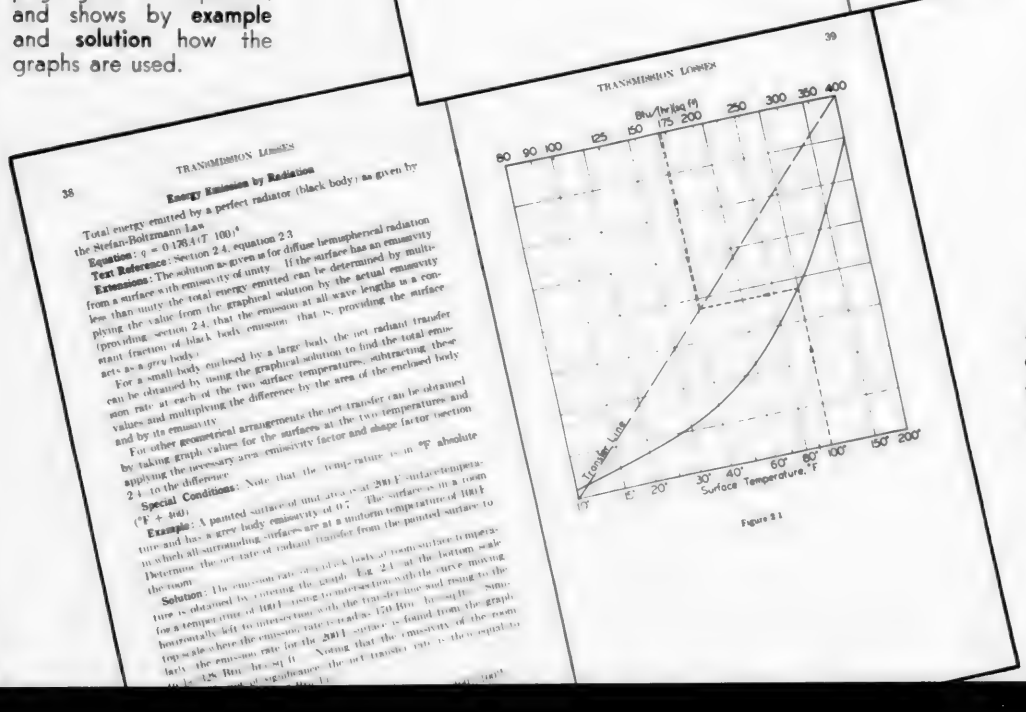

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Heating and Ventilating Design Problems

If you are concerned with problems in the design of heating and ventilating systems, here is a book that will save you hours of time and, in addition, insure accurate calculations for many complex calculations.

You can solve problems involving load determination, duct design, panel heating, solar heating and combustion analysis *directly* by means of the 96 full-page working graphs which are an outstanding feature of the book. In many cases the use of these graphs will entirely eliminate calculation, while in others the graphs serve to minimize the arithmetical work needed in solving the equations. The scales used in constructing the graphs have been selected so that *the accuracy to which each graph can be read will equal or exceed the limits of accuracy of the equation from which it was derived.*

Opposite each graph is a design example and the solution illustrating the use of the method.

Explanatory text in each chapter clearly explains the engineering background and the mathematical basis of each graphical solution. Basic handbook data are also included so that, with the simple insertion of field data, design situations can be analyzed.

Another important feature of the book is the inclusion of complete data for systems designed to utilize partial solar heating through the use of large picture windows. This is the first text on heating to include engineering data on this increasingly important subject.

The author is Professor of Mechanical Engineering at the University of California. He is the author of "Industrial Heat Transfer" and co-author of a number of books on panel heating, refrigeration and air conditioning. His knowledge of the field is well grounded on practical experience as well as theory, as he acts as consultant for many industrial firms.

CONTENTS

Introduction
Load Determination: Transmission Losses
Load Determination: Intermittent Heating
Load Determination: Ventilating and Humidification
Load Determination: Losses from Ducts, Pipes and Tubes
Fuels and Combustion
Air Distribution
Conventional Heating System Design Procedure
Panel Heating Design Procedure
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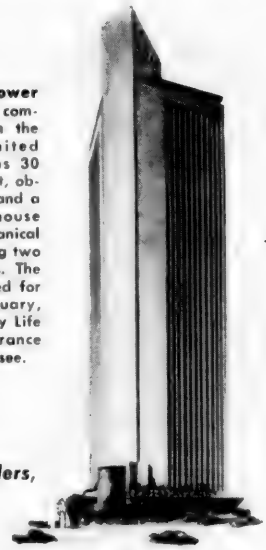
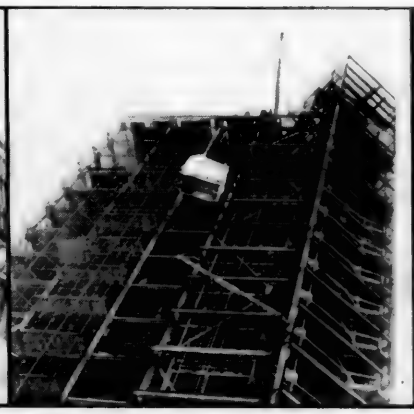


Life and Casualty Tower will be the tallest commercial structure in the southeastern United States. It contains 30 floors plus basement, observation platform and a three-story penthouse containing the mechanical equipment—including two VP package boilers. The building is scheduled for occupancy in January, 1957. It is owned by Life and Casualty Insurance Company of Tennessee.

. . . anywhere the floor-loading's adequate, of course. In Nashville's nearly-finished Life and Casualty Tower, two Combustion Engineering Package Boilers, Type VP, were installed in a 32nd-floor penthouse — nearly 400 feet above the street. The pictures show how the job was done.

Take It Away—First of two VP Boilers—27,000 pounds—clears the truck bed in the first step of its 32-story journey. VP Boilers come fully assembled, ready for water, rail or road shipment anywhere in the world.



Almost Home—This VP has probably shattered the altitude record for boilers now—and it has another 30 or 40 feet yet to go. That's one of the advantages of the VP. You pick the spot and the rigging boys will find a way to move it in.

Boiler in a Penthouse—Now it's almost settled in its permanent skytop home; about set to bring up number 2. When the floor is ready, they'll hook up fuel, water and the job's done. They'll burn gas in these boilers, with oil as stand-by.

The completely shop-assembled VP Boiler, shown at left, is available in fourteen sizes from 4,000 to 40,000 lb steam per hr ... for operating pressures up to 500 psi ... for pressure firing of liquid or gaseous fuels. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The larger lower drum—30-inch diameter—permits a simple, symmetrical tube arrangement ... greater water storage capacity ... easy access for washing down or inspection. A low speed centrifugal fan which is exceptionally quiet in operation is standard equipment. The simple baffle arrangement results in low draft loss ... simple soot blowing ... no dead pockets ... high heat absorption. The VP is enclosed in a reinforced, gas-tight, welded steel casing, and shipped completely assembled with firing equipment, fittings and forced draft fan. For foundation, the VP Boiler requires only a simple concrete slab.

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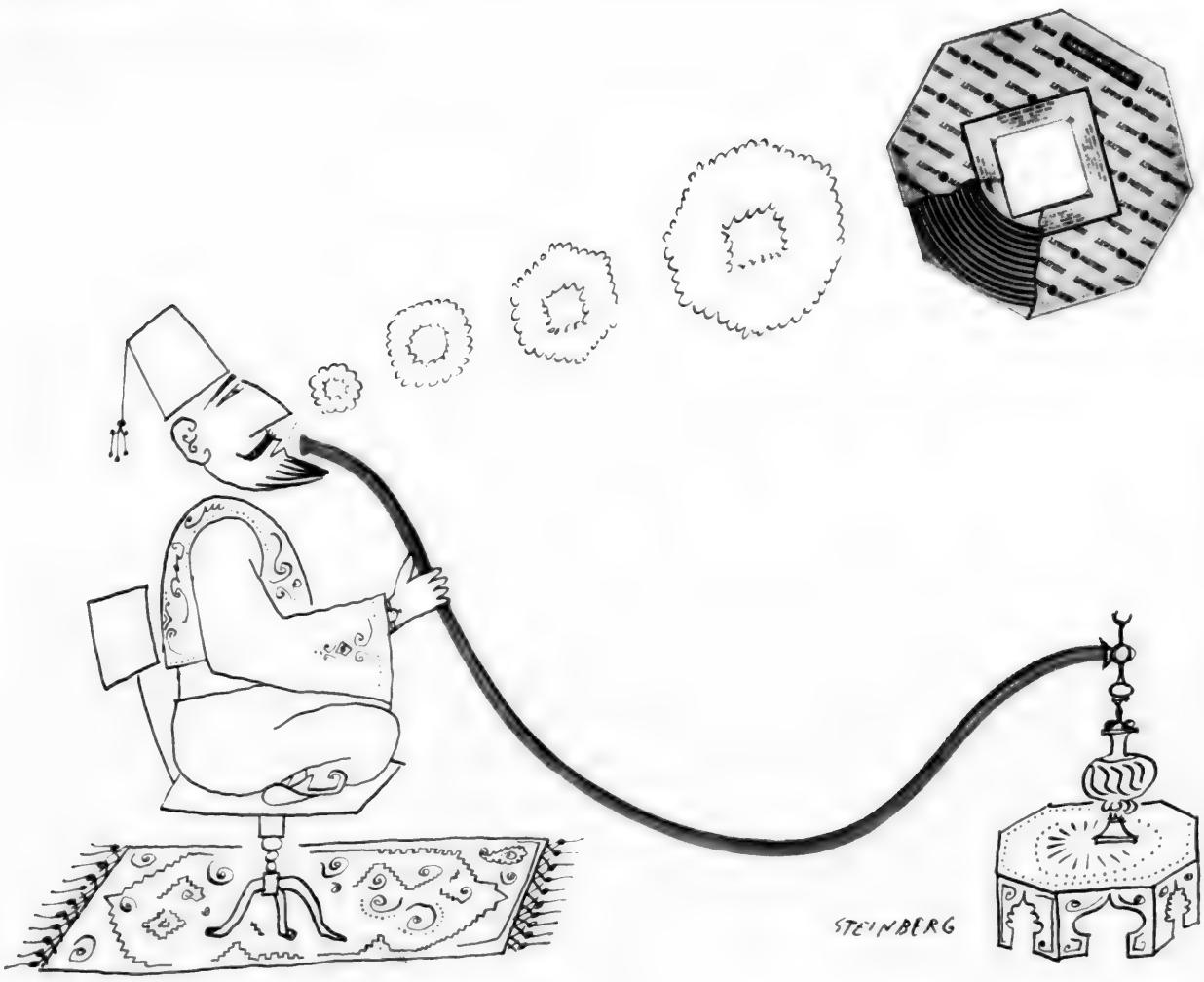

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And in distribution . . . our nationwide network of Service Offices and Mill Depots has earned for Lewin-Mathes a reputation for service and efficiency second to none.

What's *your* "pipe dream"? A new building? Improving your home? Producing a better product? If it calls for tube or pipe, be sure your architect, engineer or designer calls on Lewin-Mathes—the *integrated specialists!*

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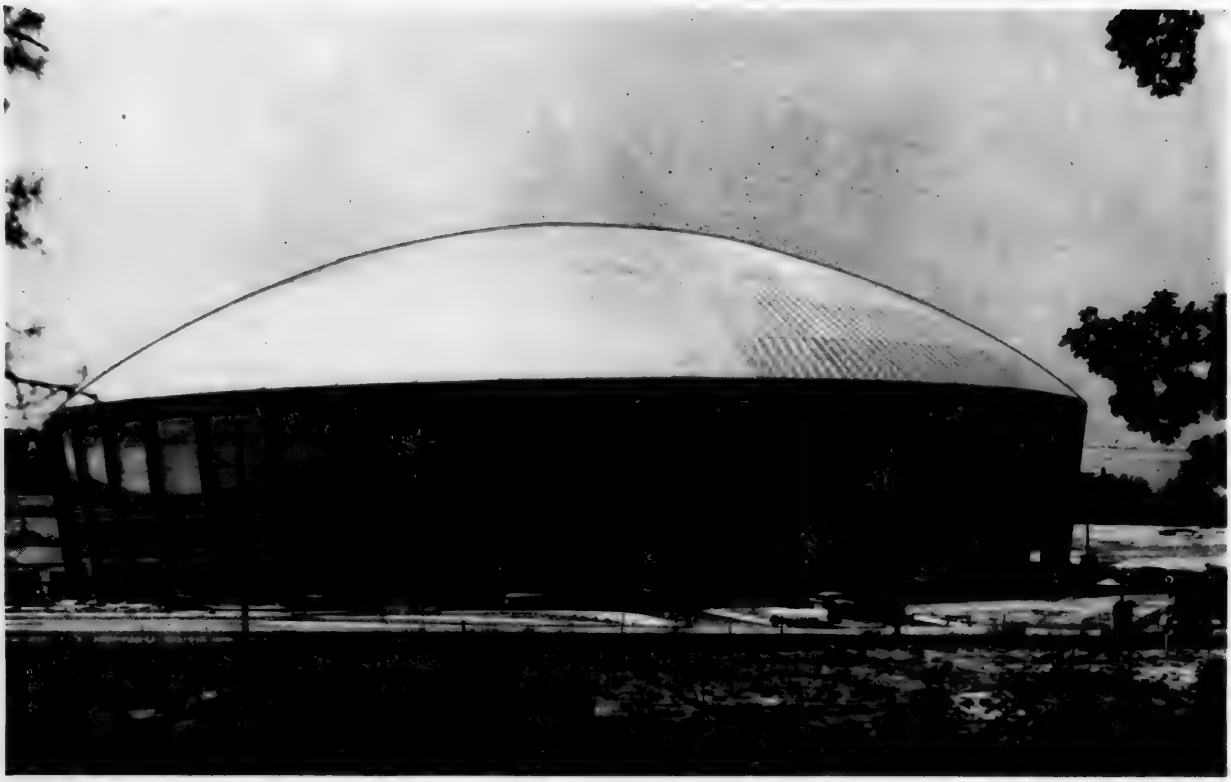

Marlo Heats and Ventilates Huge New Coliseum

Comfort conditioning the cavernous interior of this new 13,500-seat coliseum in Charlotte, N. C., is a man-size job. The huge aluminum dome, easily the world's largest at more than 332 feet in diameter, covers an area of two acres.

Heating and ventilating this unusual structure is accomplished by 22 Marlo Ceiling Units, with a combined capacity of 336,800 cubic feet per minute.

The building was designed by architect A. G. Odell, Jr. General contractor was Thompson & Street Co., mechanical contractor was Hopkins, Hicks and Ingle, and engineer was Mechanical Engineers, Inc., all of Charlotte.

One of the 22 Marlo heating and ventilating units suspended from the roof structure of the new coliseum.

Consult your Architect or Engineer—or write today for more detailed information on these and other Marlo Air Conditioning Units.

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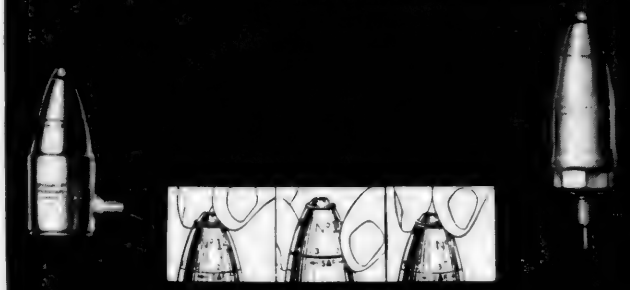
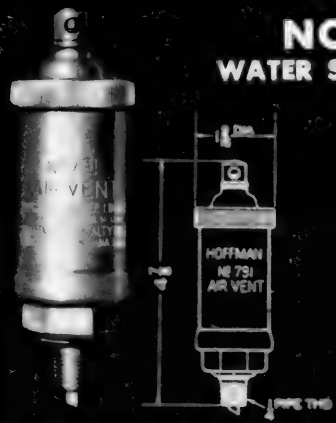


NO. 75 MAIN VENT

NO. 791 WATER SYSTEM VENT



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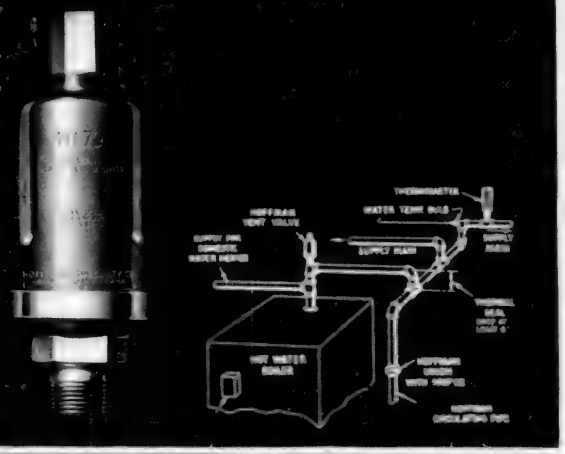

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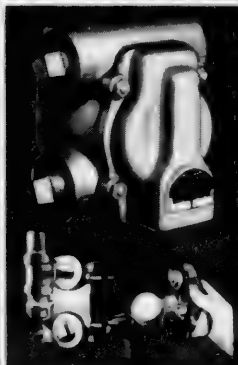

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For either one-pipe or two-pipe steam, hot water, residential or industrial heating—Hoffman assures you the correct Vent Valve for each specific requirement. For the hard-to-balance radiators, the Hoffman line includes adjustable-port valves, available for vacuum and non-vacuum systems. It is not too early to order adequate stocks of Main and Radiator Vent Valves for modernizing jobs. Call your Wholesaler.

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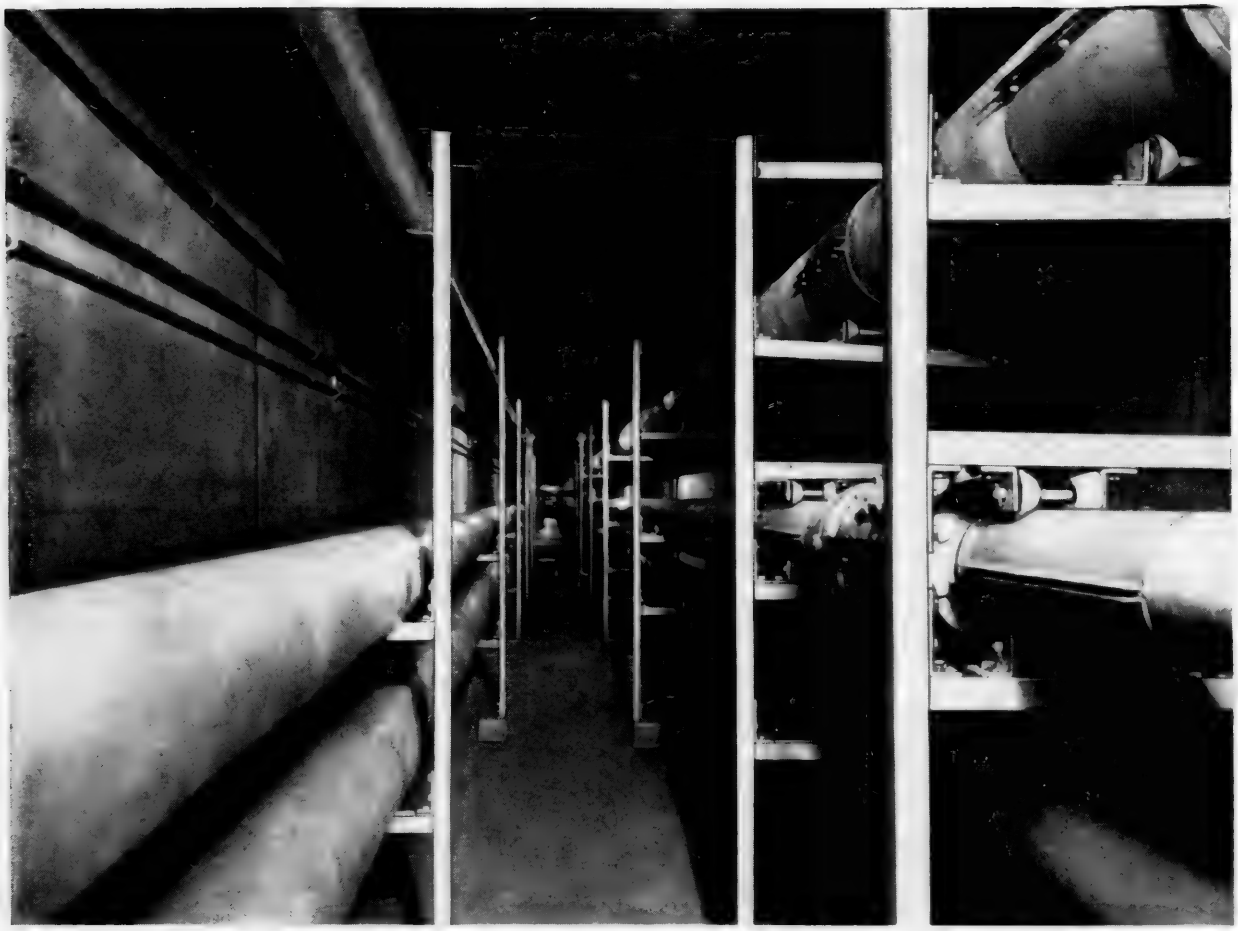

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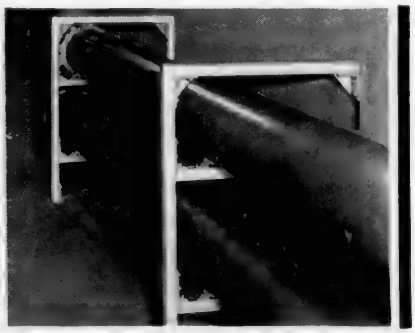
UNISTRUT framing—with UNISTRUT concrete inserts—supporting heavy water and sludge lines.



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in semi-tropical climate

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You, too, can crash the big tonnage barriers with UNICON, the industry's finest remote-type air-cooled condenser. Put Kramer's 18 years of "treasured know-how" in the proper use of air as a condenser coolant to work for you.

Photo of Kramer UNICONS mounted on roof of Handy-Andy Supermarket in San Antonio, Texas, used with 100 ton air conditioning system. Supplied through United Supply Co., of San Antonio and installed under the direction of Harold Vogt.

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In this $35 million structure there's a 26 story office building, a large underground garage, and a 9 acre four level exhibition area with the most modern facilities obtainable. Meeting rooms accommodate 25 to 10,000 people. A million visitors and exhibitors annually will enjoy its air-conditioned comfort.

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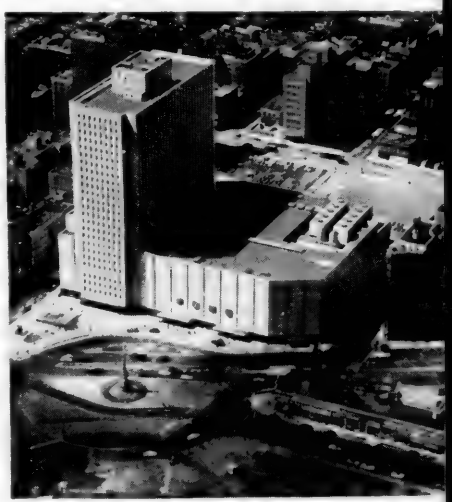
In the Coliseum exhibition halls and other spaces, conditioned air is regulated by seven Powers Control Panels, one of which is illustrated below.

Flexibility of Powers Control meets the varied needs of this unique building. For example, two separate air-conditioned systems are used, one for the Coliseum and one for the office building. Ten cooling towers on the Coliseum roof provide condenser cooling water for 4100 tons of refrigeration. Four centrifugal compressors carry the cooling load. Interconnection of the cooling and chilled water circuits permits refrigeration compressors to serve either the offices or Coliseum, preventing down-time of air-conditioning if a compressor fails.

On the periphery of the office building under the window type unit air-conditioners are supplied with high pressure primary air. Interior zones are served by a high velocity air system using warm and cool air mixing boxes with ceiling diffusers and side wall outlets.

The large Coliseum areas are supplied by high velocity single zone air systems while the small meeting rooms, office areas, etc. are served by low pressure fan units and by high velocity double duct systems.

Consult Powers on your next control job. Be it large or small, if quality, superior performance and engineering know-how are important, call your nearest Powers office.



New landmark dominates Columbus Circle

Powers Air-Conditioning Control Systems also used in these famous showplaces:
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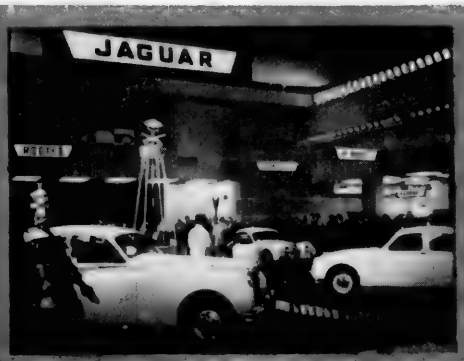
65 Years of Automatic Temperature and Humidity Control



Left: Some of the 140 foreign cars in the auto show from Britain, Germany, France, Italy and Sweden.

Right: Switzerland, one of 50 foreign countries at the International Stamp Show, provided visitors with a long special glass top table beneath which stamps were displayed on two moving belts.

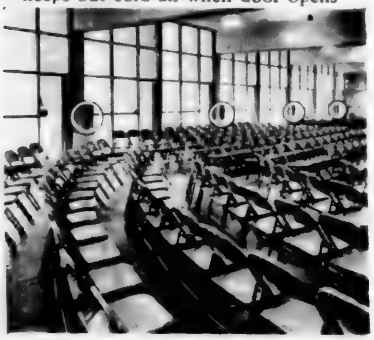
4 exhibition floors may be used singly for four separate simultaneous shows or any combination of floors may be used together.

(c75)

It's easy to give large rooms and entryways that Warm welcome

Type BF cabinet units, equipped with plenum bases and partially recessed in wall, maintain comfort in the hallways of this large midwestern elementary school.

Recessed in the counter, a Type BF keeps out cold air when door opens



Using ducts, cabinet units heat adjacent rooms as well as auditorium.

the answer . . . Modine Cabinet Units

For that lasting "warm-welcome" first impression—in new buildings or remodeling jobs—there's nothing like Modine Cabinet Units for *performance, styling, versatility.* Five smartly-designed models—120 to 640 Edr—offer an unmatched variety of installation arrangements and mounting possibilities for quiet, efficient, economical heat distribution.

Some can be used for steam or hot water heating . . . others heat with hot water . . . cool with chilled water. They can be installed upright or inverted . . . fully exposed, recessed or concealed . . . on walls, floors or ceilings. All can be used with or without ducts. What's more, with inexpensive accessories, Modine Cabinet Units can be adapted to introduce, filter, heat and distribute fresh outside air for ventilation. Above all, they're economical—cost far less to install than individual unit ventilators or air conditioners.

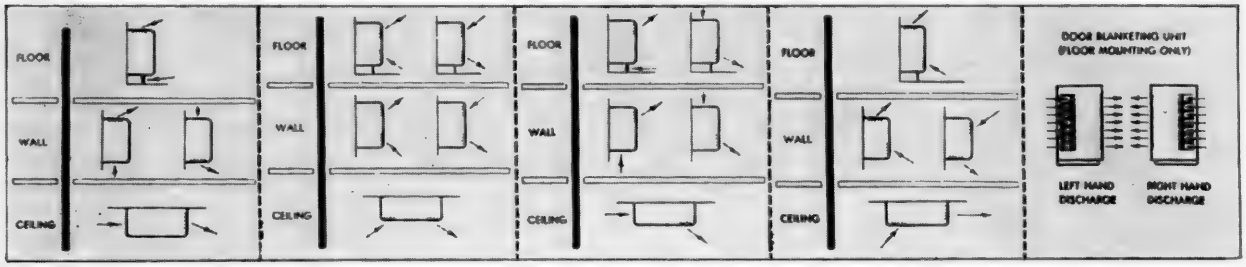
See the Modine representative listed in your classified phone book. Or write Modine Mfg. Co., 1511 DeKoven Ave., Racine, Wis., for Bulletin 552.

Modine CABINET UNITS

In Canada: Sarco, Ltd., Toronto

C-1315

Choose from over 20 variations to match your individual room requirements



YOUR BIGGEST AIR CONDITIONING PROBLEM:

*Rising prices! Cost per cubic foot of air conditioning ducts and building space has tripled since 1930!**

YOUR MOST URGENT AIR CONDITIONING NEED:

An air handling unit which meets all design and functional objectives yet requires only a minimum amount of space!

YOUR BEST AIR CONDITIONING SOLUTION:

New WORTHINGTON central station units that offer unlimited choice of location!

FREE DATA BOOK!
Gives you all the facts to figure the job with the most compact, adaptable air handling units ever developed!

Included are photos of units, engineering and design features, specifications, physical data . . . *plus*

Direct Expansion Coil Data • Selecting the Correct Unit with Direct Expansion • Sample Water Cooling and Water Heating Problem • Psychrometric Chart • Heat Control of Dry Air • Log Mean Temperature Chart • Mean Effective Temperature Tables • Correct Fan Selection–Sample Problem and Fan Data • Dimensional Drawings

This fact-filled, easy to use Worthington 52-page Data Book is a "must" for every architect, engineer, contractor and builder! Send for your copy today.

*Architectural Record, May 1956

WORTHINGTON

CLIMATE ENGINEERS TO INDUSTRY, BUSINESS AND THE HOME

CLIP COUPON AND MAIL!

WORTHINGTON CORPORATION
Box 35
Kearny, N. J.

Please send me free copy of Worthington's new booklet on Central Station Air Conditioning Units.

Name _____
(Please print or type)

Company _____

Street & No. _____

City _____ Zone ____ State _____

A. 6. 118

Archbishop Thos. J. Walsh Homes. 13 buildings; 630 units.
Rev. William P. Hayes Homes. 11 buildings; 1458 units.
Otto E. Kertchner Homes. 8 buildings; 730 units.

Thousands of MARSH Valves and Traps for this big Newark project!

A bright spot in the dark clouds that overhang Humanity is America's big drive to solve the housing problems of congested cities.

The development pictured here is in Newark. It consists of four projects, comprising a total of 41 big buildings containing more than 20,000 rooms. The four developments provide about five rooms each for over 4,000 families—enough dwelling units to house the entire population of a city of nearly 20,000 people.

Naturally, in buildings like these it is necessary for the sake of initial economy to rule out frills and embellishments. But never forget that the vital need for long-range economy dictates *highest quality in every basic element of construction.*

That is why only the best heating equipment is used in the four big central heating systems. That is why the systems are equipped throughout with thousands of Marsh Radiator Valves and Traps—the kind that will stand up across the years.

Yes, in buildings of every size and kind you will find Marsh Valves, Traps and Vents . . . selected by men who know the economy of using only the best. Let the Marsh man work with you on your next job.

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*, Dept. U, Skokie, Ill

Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd St., Edmonton, Alberta

Newark's big scale housing

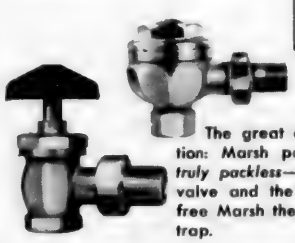
The four projects—three of them completed and fully tenanted—provide homes for 4,374 families in the 20,681 rooms of 18 12-story; 13 8-story, 1 7-story, and 5 3-story buildings. The project is described as:

Housing Authority,
City of Newark, N. J.
David Kent, Dir. of Development — Louis Danzig, Exec. Dir.
Steve Galaida, Mechanical Engineer

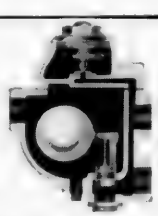
The projects are:

1. Otto E. Kertchner Homes
   General Contractor: HRH Construction Co., New York, N. Y.
   Heating Contractor: John H. Joyce, Newark, N. J.
2. Archbishop Thos. J. Walsh Homes
   General Contractor: Terminal Construction Co., Wood Ridge, N. J.
   Heating Contractor: John Cooney, Harrison, N. J.
3. Rev. William P. Hayes Homes
   General Contractor: Terminal Construction Co., Wood Ridge, N. J.
   Heating Contractor: Paramount Plbg. & Htg. Corp., New York, N. Y.
4. Christopher Columbus Homes
   General Contractor: Terminal Construction Co., Wood Ridge, N. J.
   Heating Contractor: Paramount Plbg. & Htg. Corp., New York, N. Y.

The Christopher Columbus group of 8 12-story buildings is not illustrated, but is now completed.



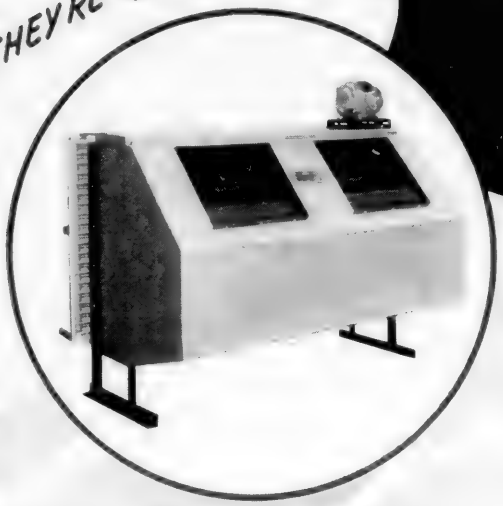
The great combination: Marsh packless—*truly packless*—radiator valve and the trouble-free Marsh thermostatic trap.

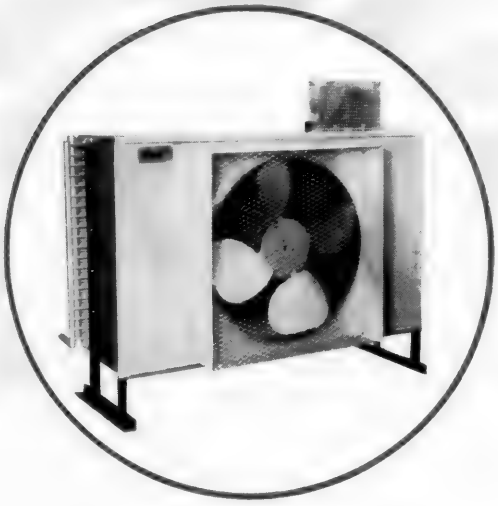


The Marsh float and thermostatic trap. There is a Marsh trap for every heating service.

MARSH *Quality Heating Specialties* **SINCE 1865**

NEW 'BC' UNITS EXTEND RANGE OF BUSH AIR COOLED CONDENSERS to 20 TONS...





NEW Bush 'BC' Blower Condensers permit air conditioning and refrigeration systems to operate *without water* . . . provide the answer to excessive water costs, limited supply, excessive impurities or disposal problems.

Available in capacities up to the 20 Tons, new Bush 'BC' Blower Condensers feature *low noise level . . . quiet operation.*

Patented Inner-Fin coil construction, *a Bush exclusive,* makes these the most compact units on the market. Units are easy to install, have rugged all-steel cases with durable rust-resistant finish . . . are available arranged with either blower fan or propeller fan.

The BUSH line of water-savers, most complete in the industry, also includes:

'CDT' COPPER DECK COOLING TOWERS with all copper decking. **'IEC' INNER-FIN EVAPORATIVE CONDENSERS** featuring patented inner-fin coils. Both units available with blower or propeller fan. Capacities from 3 to 90 Tons.

'PFC' PROPELLER FAN CONDENSERS — Two basic models, 2.2 Tons and 3.3 Tons can be combined by mounting in banks to obtain any desired tonnage.

'PS' PRESSURE STABILIZERS — automatically maintain satisfactory head pressure when air cooled condensers operate outside in low ambient temperatures.

Write direct for complete information or contact your experienced BUSH representative for valuable engineering and application assistance.

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ELECTRIC-ELECTRONIC

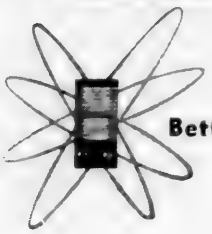
Automatic Controls

Why electronic control?

...eliminate tampering with thermostat settings by unauthorized personnel

Remote temperature adjustment at "Control Center"

Assure owner satisfaction with temperature control systems by making it impossible for unauthorized personnel to change the thermostat setting in multi-person areas. With Barber-Colman Electric-Electronic Controls, temperature settings for a zone or a building are made at a remote "Control Center" by the operating engineer or maintenance supervisor. No guards or key adjustments (which sometimes just challenge the ingenuity of the individual) are needed. These same instantly responsive sensing elements are available with adjustment levers for individual room control in private offices.



Better control . . . *electronically!*

For the complete story on how Barber-Colman Electric-Electronic Control Systems can help you solve your control problems, contact your nearby Barber-Colman Field Office.

Barber-Colman Company

DEPT. H, 1302 ROCK ST., ROCKFORD, ILLINOIS, U. S. A.

Why Arizona Public Service chose Triple-Zone Gilsulate to protect 1200-foot fuel and steam lines

Sought lifetime protection against heat loss and corrosion

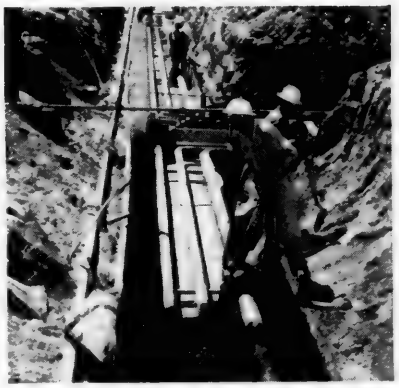
For its new Saguaro steam electric station near Red Rock, Arizona, the Arizona Public Service Company investigated several types of hot underground pipe insulation. The pipe system consists of three seamless carbon steel hot fuel and steam lines, totalling 1,200 feet, with welded joints running side by side between a 55,000-bbl. fuel oil storage tank and two 950,000 pound/hour steam generators.

Arizona Public Service Company found that GILSULATE gave the quickest, simplest and most economical system of insulation for its underground hot fuel and steam lines. Approximately 40 tons of GILSULATE were poured and tamped by 10 laborers in two 8-hour shifts — far less time and less expense than required for the other types of insulation investigated.

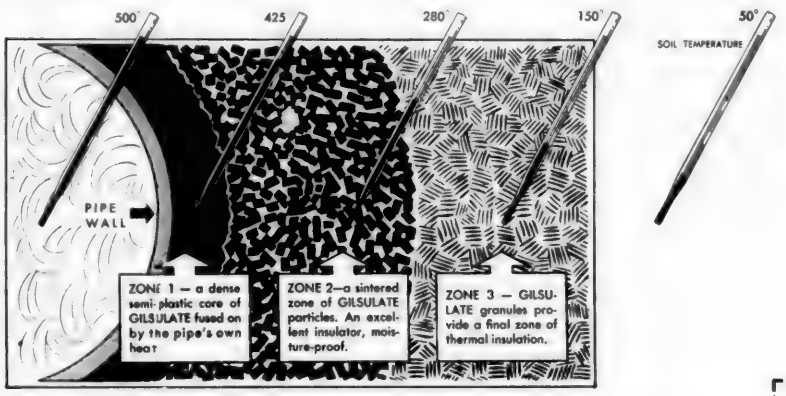
This is the experience of hundreds of other installations — *Triple-Zone GILSULATE shows the lowest cost per installed linear foot of any hot underground pipe insulation!*

Facts about Gilsulate

1. *Easy to use*—just pour, tamp and backfill...pipe heat does the rest.
2. *Forms 3 zones of protection* against heat loss and all commonly encountered hazards to hot buried pipes.
3. *Needs no sleeves* or mechanical sheaths: no mixing or special handling.
4. *Needs only* normal pipe spacing: for multiple pipe or cramped conditions.
5. *3 types* for varying temperature ranges up to 520° F.



Lines include five horizontal expansion U-bends. A 6-in. fuel oil supply line, a 4-in. fuel oil return, and a 4-in. saturated steam line leading to the fuel oil tank heater were placed side by side in a 37-in. wide trench, and covered with GILSULATE. After light tamping of GILSULATE, trench was backfilled—and the work was done.


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — a dense semi-plastic core of GILSULATE fused on by the pipe's own heat
ZONE 2—a sintered zone of GILSULATE particles. An excellent insulator, moisture-proof.
ZONE 3 — GILSULATE granules provide a final zone of thermal insulation.

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

American Gilsonite Co.
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...eliminate tampering with thermostat settings by unauthorized personnel

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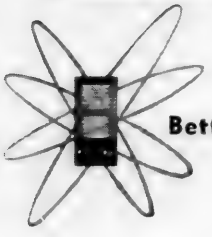

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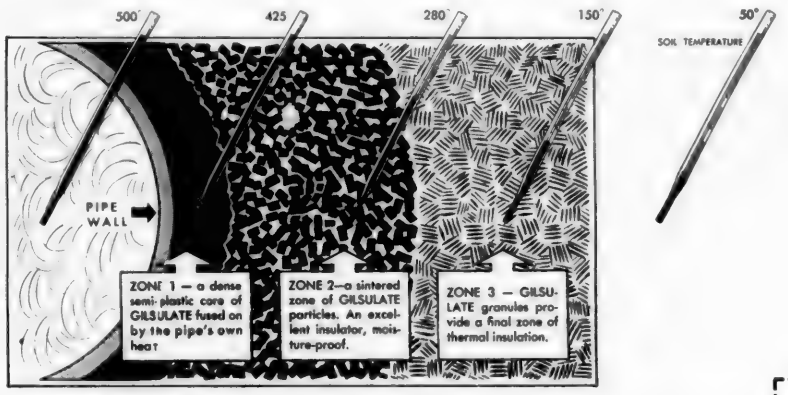
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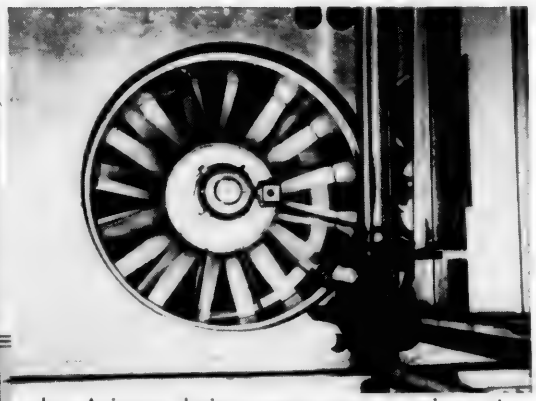
Ventilation Problems: Gone with the Joy Axivane Wind

Compact Joy installation at Boqueron, Venezuela, moves huge quantities of air.



Joy Axivane design means power savings at Alcoa's Texas Plant.

Space-saving Joy fans are installed as part of the duct system at Reliance Electric's Ohio Plant.

Dependable Joy installation circulates freezing air in California Cold Storage Plant.

'Round the World, JOY Handles the Hard Ventilating Jobs

Joy handles the hard jobs in ventilation round the world because a Joy fan develops greater volume of air per pound of fan and motor—because of simplicity of installation that eliminates duct offsets, elbows, drives and guards. The JOY Axivane fan is a favorite of ventilating engineers because JOY installations save up to 70% of the space occupied by other fans of equivalent performance. This space-saving feature of Joy fans makes possible more profit-making production area.

An Axivane fan is an integral part of the duct in which it is installed. Pre-lubricated, double-shielded ball bearings permit the fan to be installed in any position—give you long service without attention. These precision air-moving machines are marvels of efficiency and compactness. They provide economical, efficient air circulation for all types of commercial and industrial applications.

You can choose from a standard line of over 136 models specially designed to meet the needs of modern industry. The Joy Axivane Series 1000 is a standard line available to you ready for installation.

For complete information about the JOY standard line of 136 models—to learn about JOY custom engineering service, write to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario*

Write for FREE Bulletin 17-40

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WORLD'S LARGEST MANUFACTURER OF VANEAXIAL-TYPE FANS

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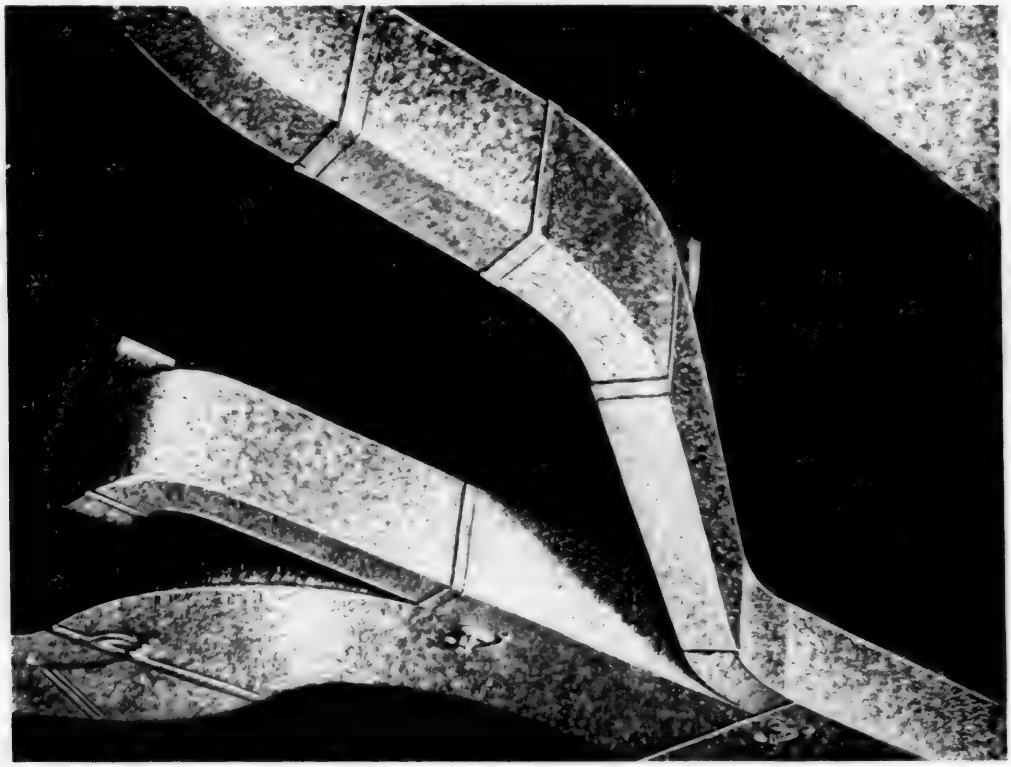

anything that can be made of steel sheets can be made of

Your very first sheet of Wheeling SOFTITE will prove to you that here is a galvanized sheet that is *different*. It's easier to work. No matter *how* you form it, Wheeling SOFTITE will not chip or crack! As a matter of fact, the zinc coating on this new ductile sheet is so *tight*-coated, you can use it to make anything that can be made of steel sheets.

As a result you can tight-crimp and lock-seam Wheeling SOFTITE without breaking the coating. It stays good-looking and rust-resistant far longer.

Make the test yourself. Put Wheeling SOFTITE through any operation and see if it isn't the most workable galvanized sheet you have ever used.

Get samples and full information today. Write Wheeling Steel Corporation, Wheeling, West Virginia.

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SOFTITE®

GALVANIZED SHEETS

IT'S WHEELING STEEL

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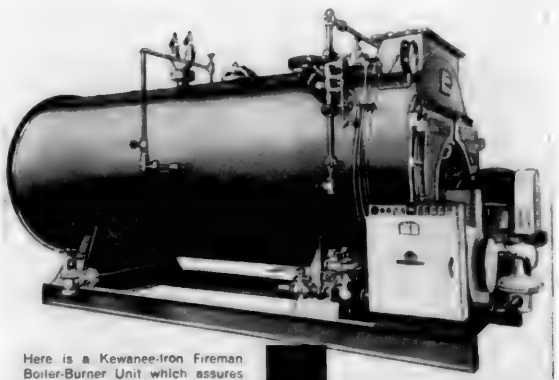
徐行

EAST MAY BE EAST . . . WEST MAY BE WEST . . .

but *"Cruising Speed"* boiler operation is best . . . *anywhere*

Gakkō Tosho Printing Company, Hara-machi Plant, Tokyo, Japan
Architect: Mr. H. Kishida and Mr. K. Tange, Tokyo, Japan
Engineer: Mr. K. Kawai, Toyohashi, Japan
Heating Contractor: Matsuhisa Industrial Company, Numazu, Japan

In Far Away Tokyo, Kewanee Boilers Were Selected by Gakkō Tosho Company Because They Provide Reserve Power to Meet Fluctuating Needs. No matter how you say it, in English or Japanese, "cruising speed" boiler operation adds up to the same thing in any language . . . higher efficiency, lower fuel cost, lower maintenance, less wear and tear, longer boiler life. And that's what management at Gakkō Tosho Company wanted in their modern Tokyo printing plant. So they selected Kewanee Reserve Plus Rated Boilers. Here they were assured reserve power to automatically supply steam quickly to operate automatic printing equipment. Reserve power in boilers means "cruising speed" operation . . . dependability . . . with enough power always on tap faster, surer. It means boilers rated on nominal capacity. Boilers rated on maximum capacity run at constant top speed, pile up maintenance and fuel costs—cut boiler life. Next time, choose Kewanee Boilers. Just call for the Kewanee man—in English, Japanese or Sanskrit—and he'll come running to serve you. KEWANEE BOILER DIVISION of AMERICAN-STANDARD, 101 Franklin Street, Kewanee, Illinois



Here is a Kewanee-Iron Fireman Boiler-Burner Unit which assures 'round the clock "cruising speed" operation at the Gakkō Tosho plant.

KEWANEE
reserve plus rated

KEWANEE BOILERS

You can depend on Kewanee engineering

to make or meet specifications

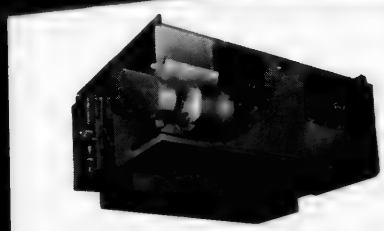
McQuay HC Line

THE MOST VERSATILE HEATING AND VENTILATING UNITS IN THE INDUSTRY

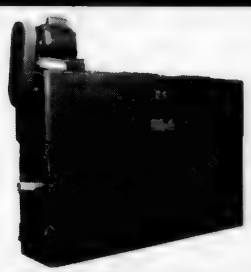
The McQuay "HC" line has been designed for a wide range of applications . . . schools, churches, industrial plants, public and office buildings and other installations . . . wherever quiet, high volume heating and ventilating is required.

Solve your specification problems with McQuay "HC" units where you may select from 17 sizes ranging in capacity from 1280 CFM to 32,500 CFM. You also have a choice of—not two or three— but *eight* capacity ranges in both standard and jet tube steam coils. (Or up to four rows of hot water coil if you prefer.)

In addition to this versatility in capacity, you have eight fan discharge arrangements and 18 accessory arrangements to choose from. All arrangements are illustrated in *Catalog 344*. Write for your copy today or contact the McQuay representative nearest you.



Type "H" with internal by-pass



Type "V" with external by-pass

McQuay representatives in all major cities

McQuay Inc.

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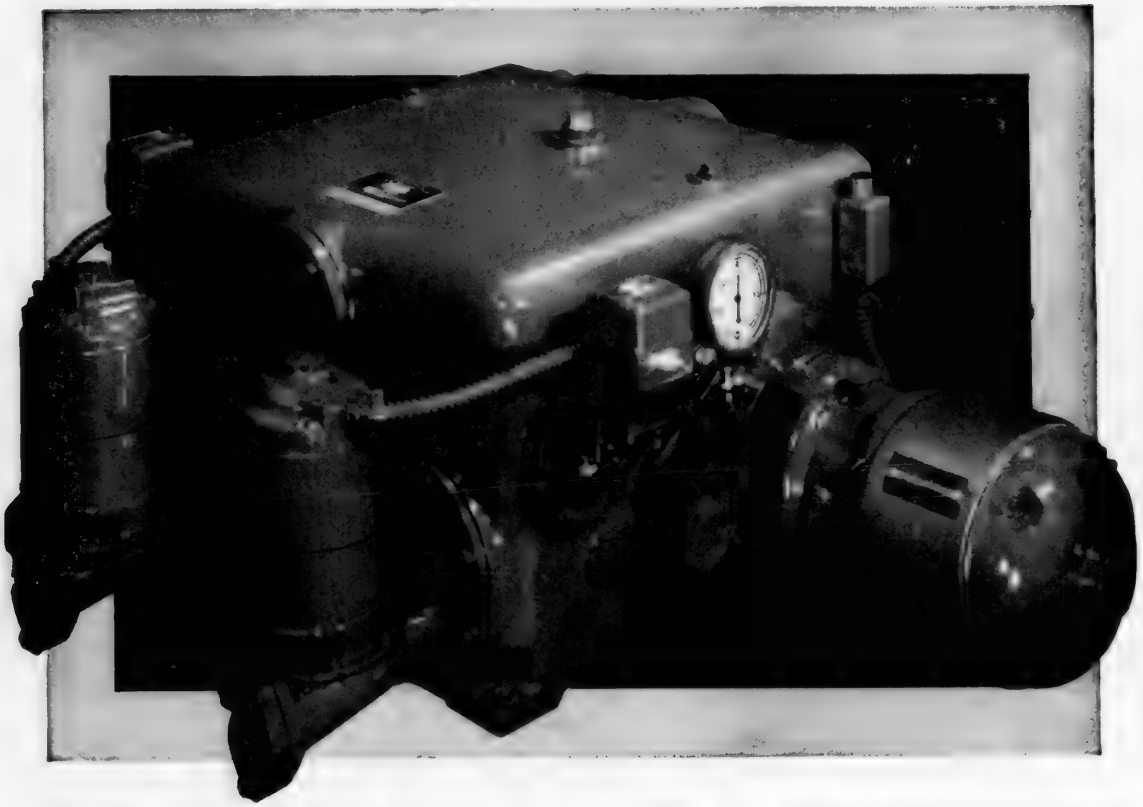
HEATING • AIR CONDITIONING • REFRIGERATION

THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS



It's the Nash CSM

No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
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- Flexibility permitting addition of radiation without changing basic pump installation.
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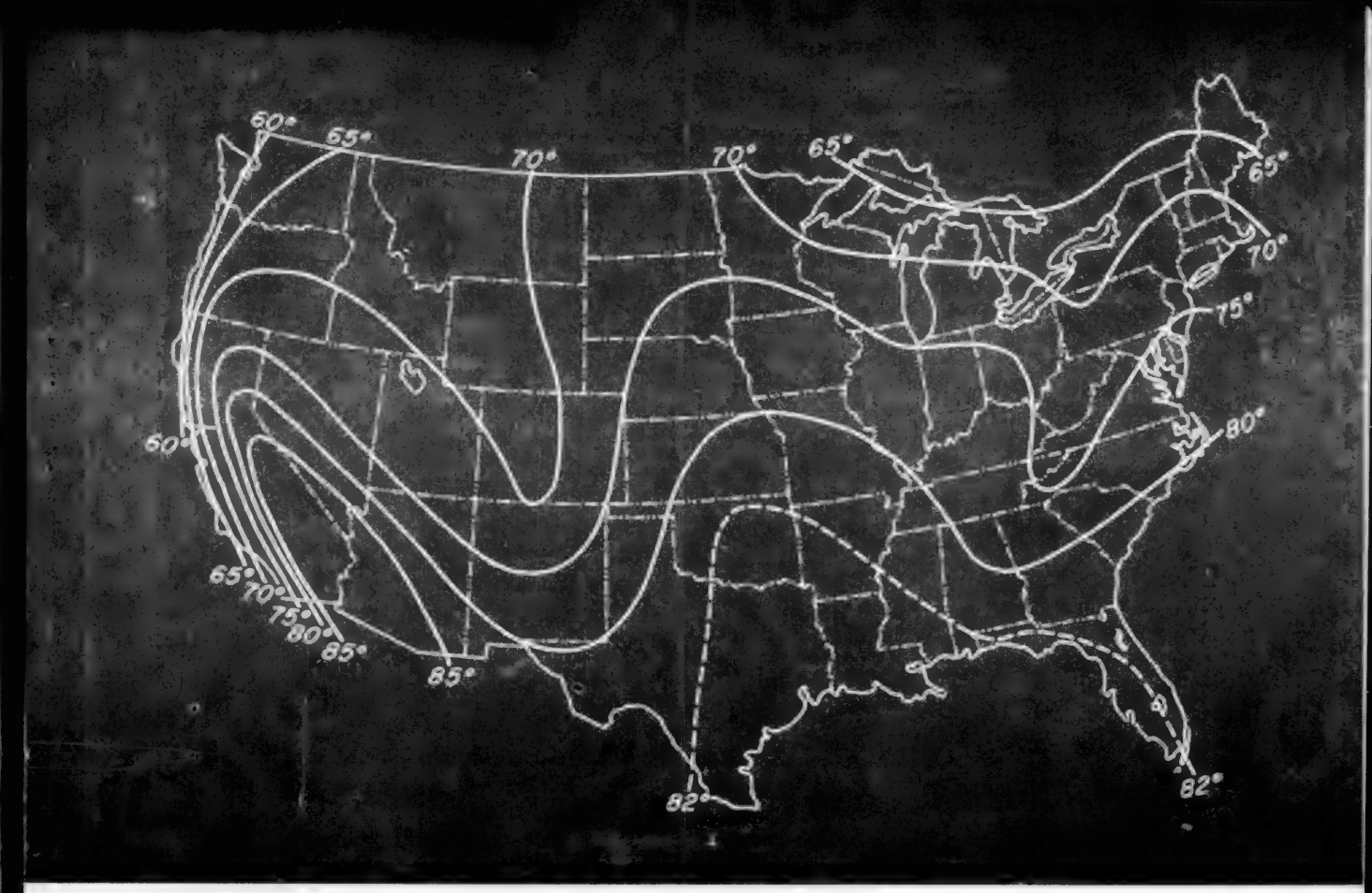

Fig. 1. Average July discomfort index at local noon. This is based on observations at 157 stations from 1931 through 1934.

Measuring the Need for Air Conditioning

EARL C. THOM

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Increased attention to summertime discomfort is a basic reason for the rapid growth of air conditioning. The author has examined possible applications of a Discomfort Index as a means to establish the need for air conditioning. A number of maps are included which, by means of isolines, graphically illustrate the data from a fairly large number of observation stations.

THE PROBLEM of a method for determining air conditioning requirements has been examined frequently during past years and many solutions have been advanced. A few of these ideas are:

1. Computation of "cooling degree-day" values was suggested similar to those of the heating degree-day concept in use for nearly 30 years to estimate fuel consumption. The cooling degree-day was originally defined as the number of degrees that the mean dry bulb temperature for the day exceeded a base of 75 deg F. For each station, the computed cooling degree day values for each separate day were accumulated to give monthly totals and long term means. Using WPA assistance, the Weather Bureau completed this work for over 200 stations. This material has remained in manuscript form, however, as it is quite voluminous and it has not been generally accepted as a completely satisfactory system.
2. The total degree days of cooling weather for the month was given as the sum of the number of degrees by which each day's maximum temperature exceeded 82 deg dry-bulb.[1]
3. The summer residence air conditioning load for any month was reported to be somewhat inadequately measured by the total of the number of degrees that the dry bulb temperature for each separate hour of the month exceeded 85 deg.[2]
4. At one particular location, the air conditioning load for any one month compares to this load for a second month as the excess of mean temperature for the first

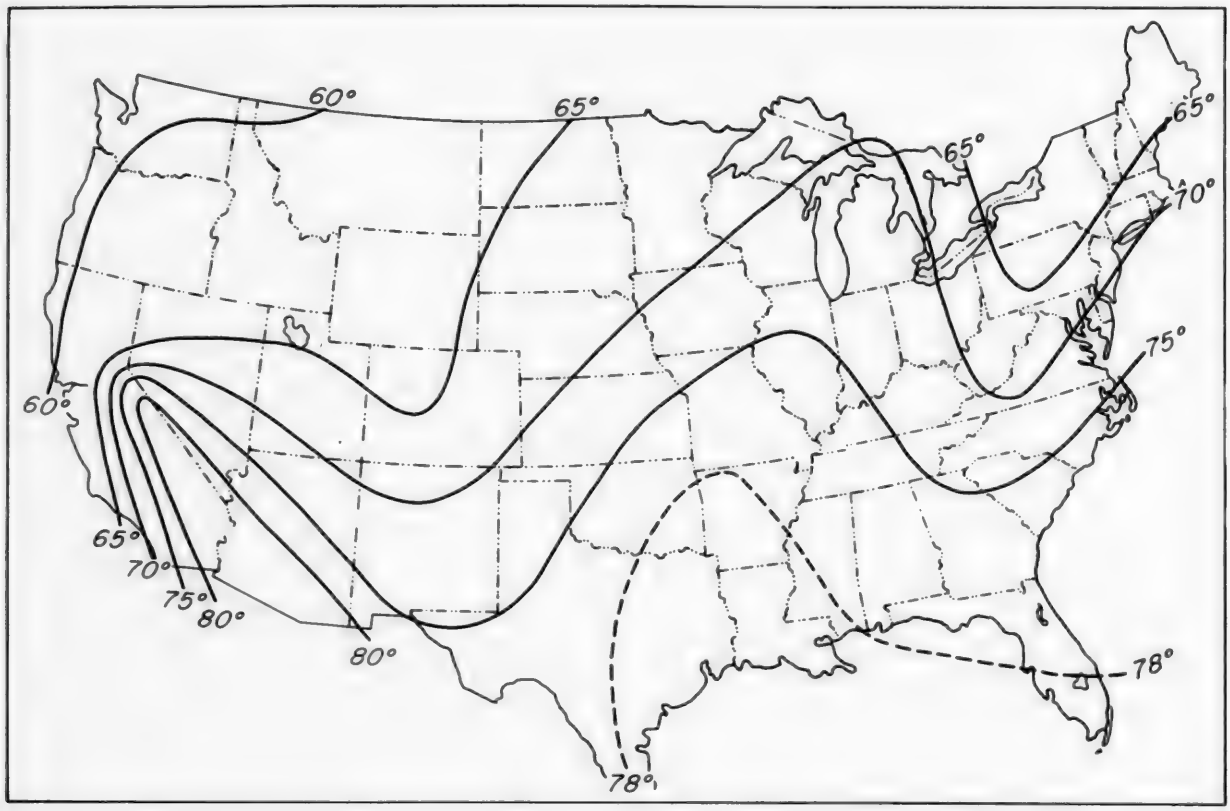

Fig. 2. Average July discomfort index based on observations made at 1:30 a.m., 5:30 a.m., 1:30 p.m. and 7:30 p.m. E.S.T., 1951 through 1955.

month over 65 deg times the number of days in the month compares to the corresponding figure for the second month.[3]

5. That the relative need for air conditioning is indicated by a computed "Climatic Factor". To get this index, a "seasonal factor" was first secured by taking one-fourth of the sum of three items: (1) the dry bulb design temperature; (2) two times the wet bulb design temperature; (3) the average total number of hours that the wet bulb temperature exceeds 66 deg during the 4-month period, June through September. This seasonal factor was then reduced to a climatic factor by dividing by 782, which was the seasonal factor for Florida and was the largest state factor. This climatic factor has been published for every county of the country.[4]
6. One government agency has dividend the country into four "air conditioning need" zones and has defined each by the average total hours of occurrence during the warmest six months of specific dry bulb or wet bulb temperatures or of combinations of occurrences of these values.
7. A number of dry bulb and wet bulb summer design temperatures for use in air conditioning work have been prepared. These design temperatures have been defined in different ways by various authors.
8. Early in 1955, a task group under the direction of the Federal Construction Council issued a technical report recommending basically that summaries of dry bulb temperatures, wet bulb temperatures and a combination of the simultaneous occurrence of these temperature measurements be prepared for each hour of the day separately, for each of the six warmest months, for at least 5 years, with preference given to the most recent period. The same committee also recommended that simultaneous dry bulb and wet bulb temperature readings be published currently.

A Simple Method Is Needed

It appears obvious from the brief sampling of the suggestions, that there is a need for a generally accepted and relatively simple method of measuring air conditioning requirements. Increased attention to summertime discomfort is the primary reason for the rapid growth of the air conditioning industry. In a recent issue of AIR CONDITIONING, HEATING AND VENTILATING we find: "Shipments of room air conditioners increased nearly 400% from 1951 through 1953. Central installations for commercial buildings are expected to climb from 600 million in 1953 to 2 billion in 1959".[5]

Extensive research into the measurement of the degree of discomfort caused by various combinations of temperature, humidity and wind speed has been undertaken by the American Society of Heating and Air-conditioning Engineers with the result that the effective temperature concept and the associated comfort zones were developed and have been published for a number of years in that society's *Guide*. It has been suggested that if some way could be found to compile effective temperature data for all stations conveniently by machine methods then we would have an excellent, if not the best, indication not only of the comparative need for air conditioning but also of the air conditioning load.

To secure the effective temperature equivalent to any

pair of simultaneous readings of dry bulb and wet bulb temperatures, or the corresponding dry bulb and relative humidity readings. it is necessary to refer to the graphic concept of effective temperature values or to extensive tables which could be prepared from the basic graph. While other graphs and other names for the dry-bulb-wet-bulb combinations have been proposed, they in general appear for practical purposes to be equivalent to the effective temperature concept including the dependence on a graphic solution, or its equivalent, for every single pair of values. Since a graphic solution, as such, is not convenient for use on current data, and is not practicable when dealing with tens of thousands of observations, whether or not these observations are recorded on punched cards, we need some other approach to the problem.

Examination of Suggested Methods

It is frequently desirable to air condition indoor space in homes, offices, stores, theatres, hospitals, factories and other buildings and this need for air conditioning may be either to provide comfort to individuals or to provide special atmospheric conditions necessary for manufacturing or other processing of material. In either case, it is frequently quite impracticable to utilize outside air movement to materially improve existing inside air conditions. Outside wind speed values then would appear to affect the need for air conditioning, perhaps less than

TABLE 1—PERCENTAGE FREQUENCY AND MEAN OF DISCOMFORT INDEX FOR BALTIMORE, MD.

(The Discomfort Index is the average of the simultaneous dry and wet bulb temperatures. Figures in the body of each table are percentages, those on the bottom line of each table the mean for the period, in °F. For example, in June, from noon to 5 p.m., 25.3% of the hours show a Discomfort Index of 75 to 79°F, and for this period the mean is 73.4°F. The data are based on 24 hour readings at Friendship International Airport, Baltimore, for the period Sept., 1950, through August, 1955)

Index, °F	January					February					March				
	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours
Under 50	96.1	94.8	87.7	94.8	93.4	96.5	92.2	85.1	93.6	91.8	90.3	87.1	63.9	85.2	81.6
50-54	1.3	4.5	6.5	3.2	3.9	2.1	6.4	9.2	4.3	5.5	5.2	9.7	19.4	8.0	10.6
55-59	2.6	.6	3.9	1.3	2.1	1.4	.7	2.1	.7	1.2	3.9	3.2	9.0	5.8	5.5
60-64	..	..	1.9	.6	.6	..	.7	2.1	1.4	1.1	.6	..	6.5	.6	1.9
65-69	..	..	..	..	..	..	..	1.4	..	.4	..	..	1.3	..	.3
Mean	31.6	32.7	38.2	33.9	34.2	32.4	34.5	40.9	36.0	35.9	37.0	39.5	45.9	41.0	40.8

Index, °F	April					May					June				
	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours
Under 50	..	..	..	..	..	21.9	3.9	..	3.9	7.4	0.7	..	..	..	0.2
50-54	64.0	44.7	18.7	37.3	41.2	27.1	22.6	8.4	17.4	18.9	9.3	1.3	0.7	1.3	3.2
55-59	16.7	22.0	19.3	24.0	20.5	23.9	21.3	16.1	27.7	22.3	18.7	6.0	2.0	2.7	7.3
60-64	14.0	16.7	26.7	19.3	19.2	16.1	24.5	23.9	21.3	21.5	30.7	20.7	8.7	23.3	20.8
65-69	5.3	10.7	14.7	15.3	11.5	10.3	18.7	19.4	24.5	18.2	23.3	28.0	20.0	27.3	24.7
70-74	..	6.0	10.0	4.0	5.0	.6	8.4	20.0	5.2	8.5	16.0	25.3	20.7	30.0	23.0
75-79	..	..	10.0	..	2.5	..	.6	11.6	..	3.1	1.3	16.0	25.3	13.3	14.0
80-84	..	..	.7	..	.2	..	..	.6	..	.2	..	2.7	20.0	2.0	6.2
85-89	..	..	..	..	..	..	..	..	..	..	..	..	2.7	..	.7
Mean	47.3	51.2	56.9	52.0	51.8	55.1	59.9	65.4	60.2	60.1	63.0	68.6	73.4	68.9	68.3

Index, °F	July					August					September				
	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours
Under 50	..	..	..	..	..	..	..	..	..	..	12.0	2.7	0.7	2.7	4.5
50-54	0.6	..	..	..	0.2	3.9	..	..	..	1.0	13.3	6.7	.7	5.3	6.5
55-59	3.9	..	..	..	1.0	7.7	1.9	..	0.6	2.6	24.0	17.3	4.7	16.7	15.7
60-64	21.9	2.6	..	1.3	6.5	15.5	8.3	..	10.3	8.5	22.7	28.7	16.7	27.3	23.8
65-69	21.3	14.8	1.3	19.3	14.2	32.9	24.5	9.8	20.0	21.8	13.3	24.0	25.3	24.7	21.8
70-74	43.2	32.9	16.8	25.8	29.7	35.4	36.7	27.7	42.6	35.6	12.7	11.3	28.0	17.3	17.3
75-79	9.0	38.7	32.2	44.5	31.1	4.5	25.8	34.8	23.9	22.3	2.0	9.3	14.0	5.3	7.7
80-84	..	11.0	38.1	9.0	14.5	..	2.6	21.9	2.6	6.8	..	..	7.3	.6	2.0
85-89	..	..	11.6	..	2.9	..	..	5.8	..	1.5	..	..	2.7	..	.7
Mean	68.6	74.3	79.1	74.0	73.9	67.0	71.1	76.3	71.2	71.4	59.7	63.9	70.0	64.1	64.4

Index, °F	October					November					December				
	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours	Midn-5 am	6 am-11 am	12 m-5 pm	6 pm-11 pm	All Hours
Under 50	49.0	33.5	7.7	29.0	29.8	82.0	80.0	64.7	78.6	76.3	94.2	95.5	87.1	91.6	92.1
50-54	19.4	19.9	17.4	24.5	20.3	8.0	8.7	10.0	8.0	8.7	2.6	2.6	5.2	3.2	3.4
55-59	16.8	23.2	20.0	20.0	20.0	7.3	7.3	13.3	10.0	9.5	2.6	1.3	4.5	3.9	3.1
60-64	6.5	12.2	18.1	14.8	12.9	2.7	2.0	8.7	2.0	3.8	.6	.6	2.6	.6	1.1
65-69	6.5	5.2	20.0	6.5	9.5	..	2.0	1.3	1.3	1.2	..	..	.6	.6	.3
70-74	1.9	5.8	8.4	4.5	5.2	..	..	1.3	..	.3	..	..	..	..	..
75-79	..	..	8.4	.6	2.3	..	..	.7	..	.2	..	..	..	..	..
Mean	50.4	54.0	61.0	54.3	54.9	39.1	41.7	47.5	41.8	42.5	32.1	33.8	39.1	34.9	34.9

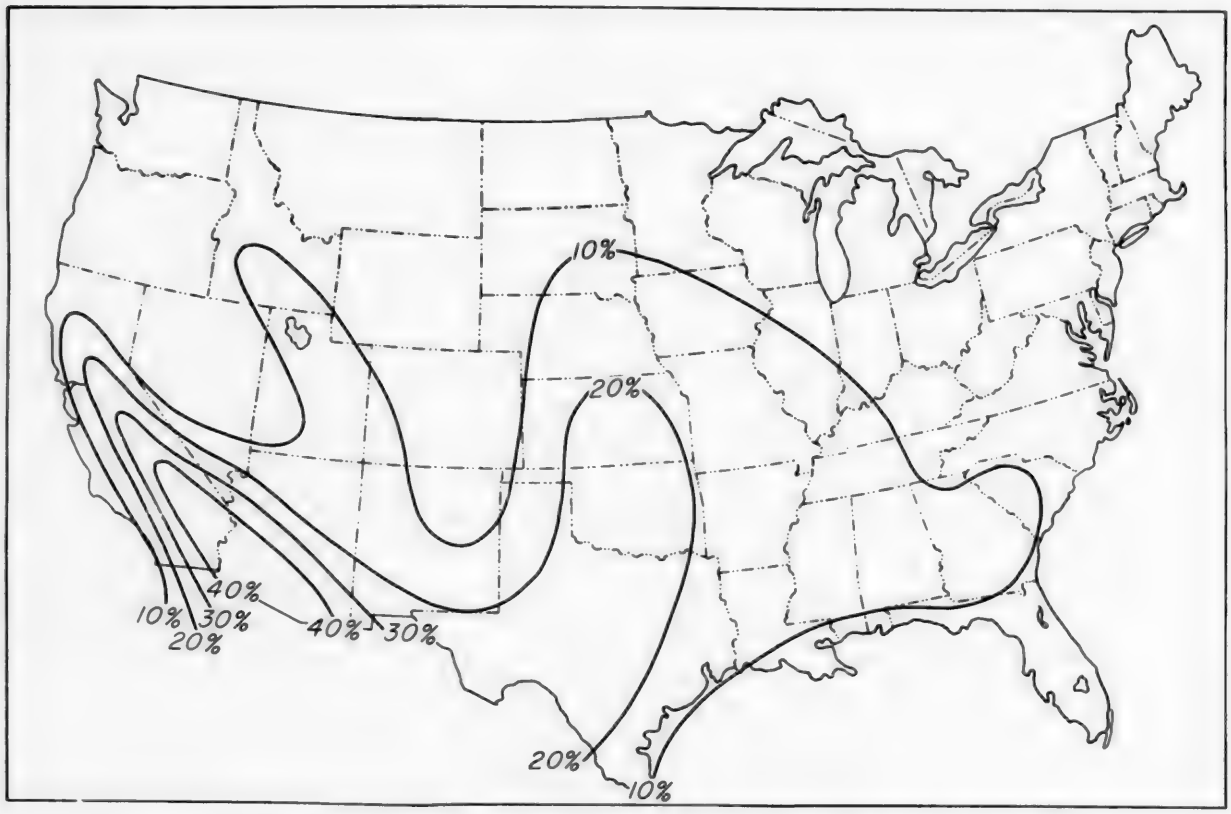

Fig. 3. Average percentage of hours, June through September, when dry bulb is 90 deg F or higher.

they effect the amount of fuel needed for heating. If we omit consideration of wind speed, it would seem that the meeting of the recommendations made by the committee as outlined in point 8 of the suggested solutions, would furnish adequate air conditioning data. The second of their recommendations, the publication of simultaneous hourly dry-bulb and wet-bulb temperature readings on a current basis, will soon be accomplished by the inclusion of suitable tables in the Weather Bureau publication "Local Climatological Summary, Supplement" which is issued shortly after the close of each month. The first recommendation, the preparation of the summaries showing the distribution of dry bulb and wet bulb temperatures separately, while requiring a vast amount of work, involves no unusual problems since hourly readings of these values are now on punched cards. The suggested summary of the distribution of a combined figure or index showing the simultaneous occurrence of wet bulb and dry bulb temperatures, however, requires special handling.

Index Used by Utility

At least one large operating utility has for some years been using the average of the dry bulb and wet bulb temperatures as an air conditioning index. This index has proven so valuable in actual practice that we have examined it to determine why this is so. We find that in the usual ranges of individual simultaneous readings of dry bulb and wet bulb temperature during the summer season, this average agrees quite closely in numerical value with the corresponding effective temperature readings. It would seem that the agreement of this index with the effective temperature concept explains why it has proven so useful in measuring the air conditioning load of the utility company, and that this easily secured index may logically be used to replace the less conveniently obtainable effective temperature. In the upper ranges it is only with dry bulb temperature readings exceeding 105 deg or when index values of 88 deg or over are reached that the difference between the index and the corresponding effective temperature becomes as much as 3 deg while similar variation does not occur in the lower range until the index falls lower than 65 deg. Since the large majority of the hourly index values which occur during the time that existing air conditioning units are in operation fall between 65 and 88 deg, it appears logical to make further use of this index, which for the purpose of identification we have called the Discomfort Index.

Discomfort Index Concept

We have therefore proceeded to examine the various possible applications of this discomfort index concept as far as practicable. As a beginning we have processed 5 years of hourly wet bulb and dry bulb temperature data for the Friendship International Airport, Baltimore, Maryland, and show the results in Table 1. This tabulation gives the monthly distribution of the hourly discomfort index by 5 deg groups, for 6-hour periods and for the full 24-hour period with corresponding averages. It is obvious that this tabulation could have been prepared in a different manner to give other details which might be desired. Similar basic data from which such summaries could be made are available on punched cards for over two hundred stations. If such tabulations were completed for all stations, it would then be possible, for

example, to place on a base map the average afternoon July discomfort index values and to draw isolines which show areas of equal afternoon air conditioning need for that month. A few summaries which show conditions at the same local time are available. One such summary[6] giving data for 157 stations for the period from 1931 through 1934 has been utilized to prepare Fig. 1 on which the average local noon July discomfort index values have been entered and isolines have been drawn. Since an insufficient number of locations were included in this summary, it was not possible to draw for details, especially in the mountainous regions, but the chart is useful in that it indicates in a general way what would be shown by discomfort index data. A number of useful charts could be prepared if summaries similar to Table 1 were available. It would be possible to draw 6-hour, 12-hour or 24-hour charts which would, for example, show the percentage of the time that the discomfort index would be expected to exceed any specified value.

In order to examine further the general appearance of a July discomfort index map, data for the four observations at 1:30 a.m., 7:30 a.m., 1:30 p.m., and 7:30 p.m., E.S.T., from 1951 through 1955 were tabulated for a selected distribution of stations and Fig. 2 was prepared. The isolines shown on this chart are again only indicative of what the complete chart would show.

Since information as to dry bulb and wet bulb temperatures separately are frequently of interest, especially when it is necessary to decide whether or not evaporative air conditioning equipment would function satisfactorily, Figs. 3 and 4, with generalized isolines, were prepared as examples of such possible presentations. Figure 3 shows in a general way the percentage frequency of hourly dry bulb temperatures of 90 deg or higher during the warmest four months based on a detailed study of hourly temperature readings at 67 stations during 1930, 1931, 1933 and 1934. Figure 4 is from the same study[6] and shows the frequency of wet bulb reading exceeding 73 deg.

Added Data Important

Much new information useful to the air conditioning industry and others will also be available when tabular material similar to Table 1 is compiled showing the distribution of dry bulb and wet bulb temperatures separately. Since local time will be used in such compilations, it will then be possible to get a direct comparison of conditions which occur at the same time of the day for various locations. If necessary, it would of course also be possible to compile duration data from existing punched card files.

Under present procedures, we have no satisfactory and generally accepted basis from which we can at any location logically compare the amount of discomfort during any one season with that of other seasons. Comparing monthly mean values of the daily maximum or the daily mean dry bulb temperature is helpful in this regard, but is not sufficiently informative. Could we not better use the departure of the discomfort index from the normal when this figure becomes available?

It is difficult to establish a new idea such as the discomfort index concept, to demonstrate its value and usefulness, to justify cost of compilation and to get general

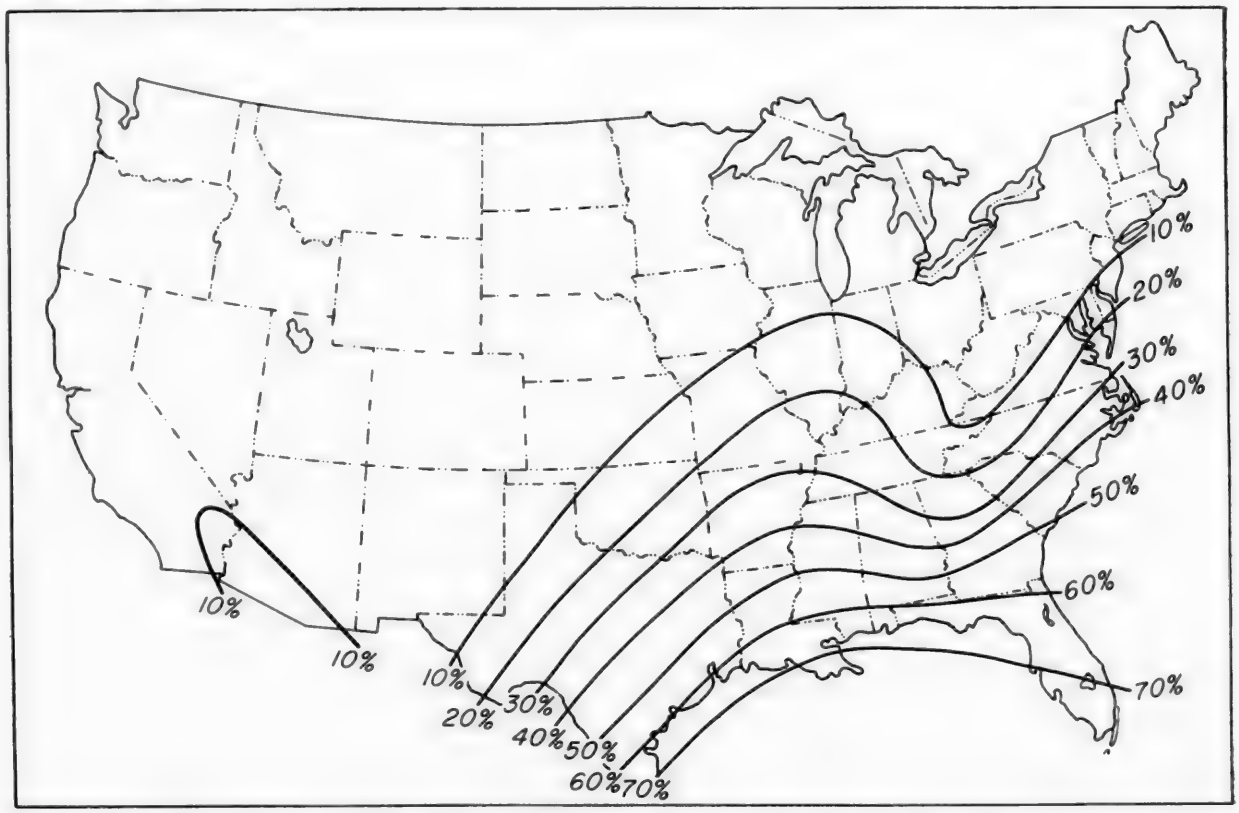

Fig. 4. Average percentage of hours, June through September, when wet bulb is 74 deg F or higher. Figures 3 and 4 are based on hourly observations made at 67 stations during 1930, 1931, 1933 and 1934.

acceptance for it. This is usually the result of a gradual growth, with the details being worked out by trial and error. It could easily be a mistake, for example, to establish now as a cooling degree day base a particular discomfort index value. If a single 24-hour discomfort index value can be found, however, which will come as near being a satisfactory basis for the cooling degree day concept as 65 deg has proven to be for the heating degree day concept then we will have a tool of considerable value to the air conditioning and associated industries. Because the use of this index has had considerable discussion, it seems likely that a number of companies have already tried out the idea in various parts of the country. Interest in a proposal by users leads often to quicker action than the recommendations of committees. The compilation of the Discomfort Index tabulation for a number of other large cities is planned. It is hoped that ways can be found to speed up this process.

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Solar Energy Studies Underway in Florida

An apparatus that has kept its automatic eye trained on the sun continuously for two years at Miami, Fla., for General Motors Research Staff, records the amount and intensity of solar energy. Called a spectroheliometer, the device recently tracked the sun from dawn to dusk for 8,104 hours.

The device automatically transfers the data on graph paper for researchers to study. Data from hundreds of charts are still incomplete, but the research staff has uncovered some incidental intelligence. For example, the spectroheliometer indicates that the Miami Chamber of Commerce may claim one point in favor of its sunshine for, the instrument reports Miami sunshine as five times more intense than Detroit sunshine.

Also, a so-called solar twinkle appears in Detroit's industrial atmosphere, apparently caused by invisible puffs of smoke floating through the air.

Developed in 1952 by GM Research Staff's Physics and Instrumentation department, the machine underwent a year's trial at Detroit before it was shipped to the Florida Test Field near Miami, which is operated by the chemistry department.

So far as is known, the instrument has produced the first continuous spectral record of the sun's daily behavior.

It was used at Miami to find out first how much sunlight falls on the Florida test field in a year. This gave the research group a measurement yardstick for indoor laboratory tests with a so-called "Little Florida" device in which paint samples are exposed to artificial sunlight from a 1,200-watt high pressure mercury vapor lamp. The immediate use of the device is to determine the effect of the sun on paint.

By knowing how much sunlight reached Miami annually, the investigators could expose paint to similar amounts of intense laboratory sunlight. In a period of weeks they hope they may duplicate many months of outdoor exposure at Miami, and any speedup of testing tempo is a research bonus.

Meantime, while the spectroheliometer was in service, the chemistry department staff put new auto finish sample panels on exposure racks each month at Miami. This was done to find out how much paint weathering varied from month to month. The amount of weathering on each new panel each month is being correlated with the spectroheliometer data of varying intensities and amounts of the sun's radiation, rain or shine.

Later, a research project was set up to determine how much sunlight varies in amount and intensity from sunrise to sunset through the four seasons of the year. This indicated that at Miami's latitude a paint sample panel in a fixed position took its worst beating from the sun either during spring or fall.

The GM instrument follows the sun's path in the same manner that astronomical telescopes follow paths of the stars. It picks up the sunlight and passes it through a spectrograph. This breaks the light into a color band stretching from the red to the blue waves light of the sun's spectrum.

Thermopiles convert five of the various light bands into electrical signals that are amplified approximately 100,000 times so that both amount and energy intensity of each band can be recorded in detail on the charts of the automatic recorders.

Air Motion Fattens Cattle

Theodore E. Bond, an agricultural engineer at the University of California, reports that it pays to fan Hereford steers in hot weather. He cooled seven such steers with a 42-inch electric fan with the result that each gained 1.03 more pounds in a day than did any of seven unfanned steers.

The fan kept the airflow at four miles an hour. Not only did the fanned cattle gain weight rapidly but they needed 400 pounds less feed to put on an additional weight of 100 pounds of meat.

The Case for Packaged Fire Tube Boilers

FRED A. LOEBEL

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To present a broad picture of pertinent facts regarding the two types of heating boilers commonly used in the commercial heating field, invitations were issued to two outstanding engineers to supply data about the type of boiler for which he is serving as spokesman. One spokesman presents the case for the packaged fire tube boiler, the other the arguments for the firebox boiler. Each engineer was given the chance to tell why, for good engineering and economic reasons, his type of boiler should be selected. In this way, the prospective specifier and purchaser of a commercial boiler has the important facts to aid him in arriving at a decision. Both authors participating in this symposium were given the opportunity to present their respective sides, so that the comments published do not necessarily represent the views of this publication. The symposium consists of this article by Fred A. Loebel as well as the one following by E. J. Grady.

MANY articles have appeared in engineering literature regarding heating boilers which covered such a wide diversity of subjects as the merits of one type versus another, the rating of the boilers, and certain design features. An examination of this material will show that there are many conflicting views and some misunderstanding.

An explanation of certain design advantages and objectives are presented as an aid to the engineer, architect and contractor so that he can better weigh important factors in boiler selection.

Factors in Package Boiler Development

Many business and economic developments followed the end of World War II. There was a boom in building construction, growth in the use of natural gas and favorable prices of fuel oil as compared to coal. All these were contributing factors in the wider use of packaged boilers for low pressure heating applications. Today, heating boilers represent a substantial portion of packaged boiler total production. Some fifteen manufacturers now offer their version of the packaged boiler to the heating trade.

The development of the packaged boiler has been done with modern methods of engineering research and development. The need to achieve compactness, pleasing appearance, and many other problems, made it a necessity to embrace sound scientific and engineering principles, and laboratory and field tests.

Heating boiler ratings today are often based on heating surface only. In some rating manuals, such as SBI and HPACCNA, specified limits on CO_2, stack temperature, and efficiency, are relatively low, since these manuals embrace the conventional field-erected boilers, which were originally designed for coal-firing and natural draft. Probably because the packaged boiler is a relative newcomer to the heating field, these manuals have not yet taken cognizance of the much improved performance attainable in the packaged design.

Each boiler type has its peculiar characteristics, and it is often a source of confusion to speak of one type in terms of another. For example, coal-fired boilers require a certain furnace size to accommodate grate mechanisms, and furnace sizes had to be large because of relatively slow combustion and low flame temperatures. Boilers for natural draft were limited in the number of passes that could be employed, and even the gas velocity in a single pass, after the furnace, had to be relatively low. Therefore, to do a given job, certain firebox or furnace dimensions, and a definite heating surface, came to be associated with boiler output.

It is incorrect, however, to use the factors of one type to judge or specify another type, as is so often done. Rather, each single type should be considered on its own merits and limitations. This is common practice in the power station field, where many variations are found in fuel and boiler design, with the result that overall heating surface has come to have little significance. A forced circulation boiler, for example, would have a different set of design or rating factors than a natural circulation boiler. A cyclone furnace for pulverized coal and forced draft would have a much different rating than a chain grate stoker furnace.

The situation is similar with the packaged boiler. Certain main elements such as oil firing, forced draft, and packaging, permitted the accomplishment of some desirable features which could be attained in no other way. As illustrations:

1. Oil or gas firing permitted much smaller furnaces than those used for coal firing, even when fired at conservative heat release rates.
2. Forced draft accomplished a number of things besides eliminating large smokestacks. It made possible higher boiler efficiencies with less heating surface. Heat transfer rates, at least double conventional boiler rates, could

Note: Comments by the author refer only to his personal experience and to that of his company. They do not necessarily apply to other manufacturers of packaged fire tube boilers.

be attained with a moderate pressure drop of about ½ to 1 in. of water per pass, depending on boiler size. In practice this level of pressure drop in the flues is relatively unimportant, since about two to three times this amount is used at the burner diffuser to create sufficient turbulence for efficient combustion.

3. Actually, these advantages could be only partially attained, if at all, without packaging. Integration permitted careful selection and design of each component in relation to the whole structure. One example of this was the need to design the burner and refractory to fit the particular boiler and furnace structure. Attempts at using conventional off-the-shelf burners simply did not provide combustion conditions which were regarded as acceptable.

Packaged boiler ratings, guaranteed by the manufacturers as a given continuous duty output at the nozzle by actual test, are limited to a large extent by furnace temperatures. The blower and motor size are fixed to prevent exceeding these design temperatures by any appreciable amount. Once the gases have left the furnace, therefore, any additional amount of heat absorbing surface is a matter of choice, and has nothing to do with any temperature limitations of the boiler.

Some 10 to 15 years ago, boiler models were redesigned from time to time in an attempt to achieve conservative designs that would provide for worse than average feedwater conditions. Almost all boilers those days were power boilers, and, due to the relatively small plants, up to 20,000 lb per hour steam capacity, feedwater treating did not always receive the attention that it does in larger plants, a situation which has not changed appreciably to this day. One of the chief considerations was to maintain furnace exit temperatures at a conservatively low value, generally about 2000 deg F. All of the present production models have temperatures well below this figure, with some as low as 1800 deg.

In order to appreciate the significance of this temperature level, it may be of interest to know that one large Midwest utility, which operates its furnaces at comparable temperatures and heat release rates, about 75,000 to 100,000 Btu per sq ft per hr, terms their furnace a cool design.

Since there is relatively little refractory in this type of boiler, it is economically justified to use the highest quality. Super-duty fired special shapes and 2800 deg castables are employed. With the low back-end temperatures noted, refractory life has been no problem.

Evolution of the packaged boiler design was based on power boiler service, which usually has a high load factor. It is for this reason that packaged boiler ratings, as given by the manufacturer, are not maximum or peak ratings, but continuous 24-hour per day ratings, which, like ratings for heavy duty industrial diesel engines, already have factors of safety taken into account.

In comparison, heating boilers seldom operate continuously. By definition, the ASHAE recommends "an outside design temperature which is equalled or exceeded during 97½% of the hours in December, January, February, and March." Also, taking into account that heating boilers generally have much better feedwater conditions than power boilers, because of the small feedwater makeup required, the manufacturer's output ratings, which are the same for heating boilers as for power boilers, are conservative—possibly to the point of over-design.

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Packaged boiler combustion chambers are often said to be small, and to have high heat release rates per cubic foot. This latter term is an example of an old rule of thumb, which is no longer significant. Consider, for example, three different furnaces fired at equal fuel rates under efficient combustion conditions. They are proportioned so that all have equal heating surface but different diameters and volumes, as shown in Table 1.

It is seen from the Table 1 that the surface heat releases are all equal at 75,000 Btu per sq ft per hr, while the volume heat release varies from 75,000 to 142,000 Btu per cu ft per hr. Based on volume heat release only, it would appear that furnace No. 3 is fired almost twice as hard as No. 1. This is not true, however. In the range of firing rates concerned with packaged boilers, it has been found that there is a close correlation between furnace surface.

TABLE 1—FURNACE HEAT RELEASE RATES

Furnace Number	Dia., In.	Length, In.	Btu Per Hr Per Sq Ft Surface	Btu Per Hr Per* Cu Ft Vol.
1	36	65	75,000	75,000
2	24	98	75,000	120,000
3	20	120	75,000	142,000

*Allows approximately 50% of furnace volume for rear chamber

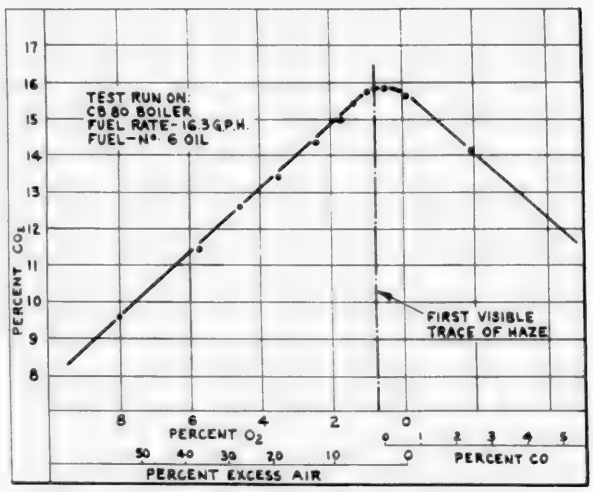

Fig. 1. Packaged burner performance with heavy oil.

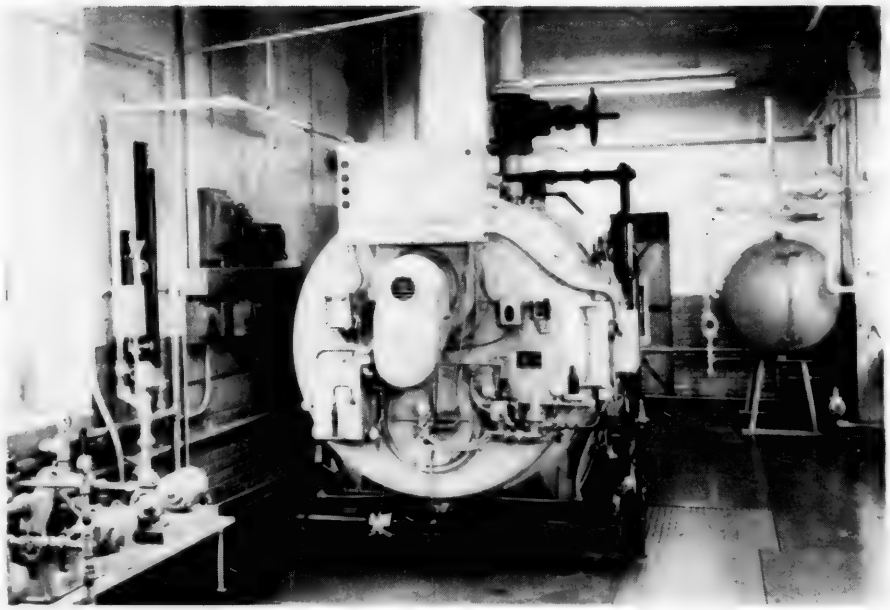

Fig. 2. Installation of a 150 hp automatic combination oil and gas heating boiler.

firing rate, and exit temperature. In the foregoing example, calculated exit temperature from empirical data would be about 1900 deg for all furnaces. Each furnace, therefore, would perform about equally well, in spite of widely varying volume heat releases. Each would require a special burner, however, for proper flame shape and turbulence.

Regarding overall heating surface, there is little that can be said, since the calculation of the amount and distribution of heating surface is a straightforward heat transfer problem of using the surface in an economical way to arrive at a predetermined boiler efficiency. With packaged boilers, the objective is at least 80%. At furnace exit temperatures of 1300 to 2000 deg, there is a shrinkage in gas volume from the furnace to the stack of about three to one. Since the convection heat transfer rate varies, as about the 0.8 power of the gas velocity, the use of multipass design is desirable to keep the gas velocity nearly constant.

For the conditions given and, again, with a pressure drop per pass of about ½ in. of water, and four passes (including furnace), it works out that 5 sq ft per boiler horsepower will develop at least 80% efficiency in small boilers, and at least 83% in boilers 100 hp and over. With this design, the efficiency curve is characteristically flat from one quarter to full load.

The largest proportion of research and development work has been devoted to combustion. All burners are designed to fit a particular boiler model, or specifically, a particular furnace shape. Whenever a new model boiler, or a new model burner is developed, it must be tailored to match up with its corresponding furnace. This work requires about three to six months of continual tests and modifications. No short-cut or method has been found to scale a burner, like a centrifugal pump, from a smaller to a larger size, and, thereby, predict performance. The reason is that there are too many variables involved which are not yet completely understood. The aircraft industry has also encountered this same problem in combustion chamber design for various sizes of jet engines, as recently reported in the literature. When the design is complete, the burner is not interchangeable with another furnace, whether larger, or smaller. The packaged boiler is, therefore, a truly integrated boiler-burner unit.

Combustion efficiencies far better than that recognized by some existing codes are attained as a matter of general practice. One combustion test is shown in Fig. 1. Note that the first visible haze appeared at a CO_2 reading of 15.8%. The important point is to have a burner which will "trim" to high CO_2 with a clear stack on the test floor, so that there is an adequate margin for clean combustion conditions in the field, where the burner can be set for about 13½% CO_2 for long-term operation without cleaning.

In comparison, the SBI Code calls for a setting of 10% plus or minus 0.2% CO_2, and a maximum stack temperature of 600 deg and a minimum efficiency of 70%. The HPACCNA Code recognizes somewhat better performance, and specifies CO_2 at 12% maximum for oil, 75% efficiency and a stack temperature of 600 deg. One of the reasons for these relatively lenient specifications is that the codes attempt to encompass a wide variety of available equipment. Some provisions, however, should be made to credit models which exceed specifications.

Other Advantages of Integrated Design

One of the most important considerations is the matter of safety. The machine is approved as a boiler-burner unit, and not the burner only, as is common with field-assembled units. Some of the main agencies involved are: Underwriters' Laboratories, Factory Insurance Association, and Factory Mutual.

The approvals of an integrated unit are important, and this feature should mean more to the prospective user than it often does. Underwriters' Laboratories distinguishes between an *A* label for a burner only, and a *B* label for a boiler-burner unit, and defines the matter in the 1954 Gas and Oil Equipment List as follows:

"Label *B* signifies that the heating unit and the burner included therewith complies with the construction and test requirements of the laboratories. If the burner of an oil-fired or gas-oil-fired unit bears the label *A*, such label applies only to the burner proper and does not cover the heating equipment in which the burner is installed."

The machine is tested as a boiler-burner unit, and this is a continuing thing and is not only done once on the pilot

model unit. There are re-tests and re-approvals from time to time as new features and new safety requirements are developed. There are also spot checks by some approval agencies of the completed production units in the manufacturer's shop.

There are also tests to insure reliability and long-life of components. Component temperatures are checked under operating conditions, and with certain specified ambient temperatures. Ignition and flame failure are two items that are tested with particular care.

The number of air changes for pre-purge must meet a minimum requirement for gas burners. Also, certain tests must be run with various oil temperatures. All light oil burners must light and operate satisfactorily with oil cooled to about 32 deg.

These approvals are also strictly limited to the device as it has been tested and approved. In cases where some users inadvertently make modifications of their own, approvals have been rescinded, and expensive field inspection and approvals are required.

A pre-engineered packaged boiler makes it possible to furnish additional aids to architects, engineers, contractors, and operators. As part of the package, it makes available certified drawings, tests, instruction and parts manuals, and starting service. These things cover the whole unit, and not only some of its parts.

Integration also provides certain characteristics, which, as a group, are not attainable in any other way. For example, by studying and developing the structure and all its working parts, it is possible to improve the appearance of a machine, as well as its function. Pleasing appearance, as everyone knows, is coming to be more and more important and desirable in our daily life. Integration also helps to attain a compact, space-saving design.

The modern boiler plant shown in Fig. 2 is an example of an integrated design. Doors with adjustable hinges provide quick accessibility at front or rear. Built-in centrifugal blowers, with cast aluminum impellers designed for quiet operation, make it possible to meet the low noise requirements of hospitals, schools, churches and similar types of applications.

From the first, up to the present day, not only prototype models have been thoroughy performance tested, but all production units as well. These tests can also be witnessed by the customer at his option for a nominal fee. The production and test facilities are completely segregated from the research testing laboratory.

It is surprising that the importance of performance testing is often overlooked. Possibly, the testing of most modern appliances and machinery is often taken as a matter of course. It is regrettable, however, that in the heating boiler industry, performance testing is the exception rather than the rule. As a result, heating boilers are rated by heating surface, which is a rule of thumb method, instead of by performance on the test floor.

It is hoped that some of the comments made will also help to shed some light on boiler ratings, to the end, that ultimately all heating specifications will arrive at a uniform basis—namely, a rating based on continuous duty output at the boiler outlet nozzle, as shown by shop tests.

The Case for Firebox Boilers

E. J. GRADY

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BEFORE considering the various features of the firebox boiler which one should study before selecting a particular type boiler, it is well to give some attention to some of the important terms used in this article, to avoid possible confusion.

Boiler. This shall be understood to include the boiler proper plus the fuel burning equipment, combustion chamber and controls.

Output. This term means nozzle output at maximum rate of firing recommended by the boiler manufacturer.

Firebox Boiler. This term refers to a conventional steel firebox type boiler designed and built under the rules of the ASME Code, rated according to the SBI Code, and meeting the dimensional requirements of that code. Almost all steel firebox boiler-burner units installed today are in this category.

Packaged Boiler. This refers to the unit commonly called a packaged steam generator, consisting of a modified Scotch boiler combined with a burner and controls and usually shipped complete. There are a number of variations in design among boilers which fall in this category and all of the statements in this article will not necessarily apply equally to each individual packaged boiler.

General

One of the primary differences between firebox boilers and packaged boilers relates to the selection and combining of the component parts.

In the firebox boiler installation, the buyer, or his representative, considers the controlling factors which are outlined later, then selects a boiler, a burner and decides whether he wants natural or induced draft. Then he contracts for the installation of the equipment he has chosen and the job is completed and turned over to the builder in first-class operating condition. The burner has been sold and installed by a company whose primary business is burners. The oil burner representative is usually located relatively close to the installation and maintains a well-staffed service department and a good stock of parts.

In a packaged boiler installation, the buyer's representative selects a boiler, but his choice ends there. He accepts the burner which comes with the boiler. He accepts forced draft even though the building may have a stack. The in-

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stallation is less likely to be located near expert service and a stock of parts.

When a man is selecting a low pressure boiler for automatic firing, he must consider a number of details so that he may be sure he is getting the boiler best suited to his requirements. Among the important considerations are safety, reliability, quiet operation, maintenance cost, economy, durability, ease of handling, ability to carry overloads, availability of fuels, and space requirements.

Safety

From the standpoint of safety, either the firebox boiler or the packaged steam generator should be ASME standard construction. It should be installed according to the manufacturer's instructions and in compliance with the effective laws and ordinances. Under these conditions, the firebox boiler and the packaged boiler will be on even terms from the standpoint of safety.

Reliability

Next to safety, by far the most important point to consider is reliability. A boiler that is not reliable cannot be satisfactory regardless of other desirable features.

A reliable boiler is one which rarely, or never, requires emergency service yet for which emergency service is available in the shortest possible time if it should be required. This is the firebox boiler because it is fitted with a "garden variety" burner in a "garden variety" setting. These well-tried, comparatively simple burners have been used for many years. They do not get out of order easily, hold their adjustments well, and competent service for these burners, as well as a stock of repair parts, are always available nearby and in a hurry.

By contrast, the burner in the packaged boiler is likely to be highly specialized so that service must come from a man trained for that specific burner and if that trained man is not available locally, there will be a telephone call to the factory and a wait for the serviceman to get there. This compounds the expense because the boiler is down longer and the charge for the repair must be higher.

Quiet Operation

Quiet operation is sometimes imperative and is always desirable. Here the firebox boiler wins on any basis of comparison. The packaged boiler usually uses a forced draft burner and it is designed with combustion chamber volume much less than that in the firebox boiler, output for output. Consequently, the packaged boiler has much higher heat release, with correspondingly greater combustion roar. Furthermore, for the units which use forced draft burners, the noise of the fan alone may be loud enough to be objectionable even without the roar of the flame.

In a factory installation, considerable noise may be tolerated although it is undesirable. In an apartment, or school, or church the noise could be intolerable so that the boiler room would require soundproofing, which could run into considerable extra expense.

Packaged boilers with their high rate of heat release and their forced draft firing often develop flame pulsation, which causes objectionable vibration of boilers and bases. This condition is so common that many engineers consider a vibration eliminator to be essential in every packaged boiler setting. This adds again to the cost of the installation.

By contrast, the firebox boiler has a much larger combustion chamber and, hence, much lower heat release. Furthermore, it operates under natural draft so there is minimum likelihood of flame pulsation, and vibration eliminators are virtually unknown with such boilers because there is no need for them.

Maintenance

For several reasons, maintenance costs will be lower with the firebox boiler installation. For example, the regular cleaning is easier, takes less time, and, of course, costs less. In the firebox boiler the operator releases a couple of hand-operated latches and swings the flue doors open, moves the platform into place, brushes the tubes (which are all one size and comparatively short), closes and latches the doors, and is ready to start up.

In the packaged boiler the operator disengages numerous bolted clips or clamps on one or both ends of the boiler, then removes a heavy closure or closures. This operation often requires a crane of some sort because of the weight of the refractory-lined closures. Then the operator brushes the tubes, swings the closure back into place, and adjusts it for position, engages and tightens numerous bolted clips or clamps and the boiler is then ready to fire. In some packaged boilers the tubes are fitted with deflectors which must be removed and replaced during each cleaning operation.

In actual practice, the entire cleaning operation for the firebox boiler is easily handled by one man and frequently takes less time than it takes for two men just to remove the closure of the packaged boiler.

Furthermore, the firebox boiler has a larger combustion chamber. Therefore, it has more space to complete combustion, less smoke and less frequent cleaning.

Similarly, the maintenance of the refractory costs less in a firebox boiler. In the first place, the refractory does not get as hot because of the larger combustion chamber, so there is less frequent need for attention to the refractory. Maintenance is easier because the repair crew has easier means of entry into the combustion chamber through the access door. They may use standard shapes and high temperature cement and almost any repair is quickly and easily made without the need for forms.

In the packaged boiler the maintenance crew must remove a heavy bolted closure to give access to the refractory. The repair may require that this closure be placed flat and may require also that the repaired part be allowed to "set" before the cover can be raised and swung back into position.

In packaged boilers of the multiple pass type, the various passes may be separated by refractory barriers intended to eliminate the short circuiting of gases between passes. When these refractory barriers deteriorate or fall down, the gases do short circuit thereby destroying the effectiveness of the boiler unit and making immediate repairs imperative.

The larger combustion chamber of the firebox boiler also provides a greater amount of prime heating surface so that the products of combustion will be considerably cooler at the entrance to the tubes. The packaged boiler has a much smaller combustion chamber, hence, greater heat release and higher furnace temperature. The smaller combustion chamber does not provide as much prime heating surface to cool the gases. As a result, the gases are much hotter as they enter the tubes and so the manufacturer is sometimes obliged to weld the tubes to the tube sheet to minimize fire cracking. This increases the cost of tube replacement.

In firebox boilers the tubes are almost invariably rolled and beaded and do not require any additional special attention to avoid such damage.

The maintenance items so far mentioned would be handled by the operating engineer and his crew. Cleaning and minor adjustments of the burner might also be handled in this manner, but major repair or overhaul of the burner would usually require outside help. Here, again, the firebox boiler has the advantage because the company that made the burner installation will be available from nearby and on short notice and with the necessary parts.

Economy

The boiler which has the lowest annual operating cost is, of course, the one with the highest economy and this is the firebox boiler.

Cost of fuel is the largest item in the list chargeable to operating cost, so that high boiler efficiency is of prime importance. However, it is the total fuel cost per year that must be charged against operation, so that a boiler must have high efficiency at the *average* output rate. Firebox boilers are designed to have highest efficiencies over the range where they will operate during the major part of the heating season. The efficiencies in this range will be over 80% at 12% CO_2, as shown by acceptance tests run by such well-known agencies as the New York Testing Laboratories. This efficiency will be maintained with infrequent cleaning because the fire is extremely clean.

Regardless of claims to the contrary, a boiler which is operated with burner set for 13.5 to 15% CO_2 will require cleaning more often than a boiler which is operated with burner set at 12% CO_2. If the high CO_2 is not coupled with CO or with unburned illuminants, there will be an increase in thermal efficiency but at the expense of more frequent cleaning.

Durability

The firebox boiler is rated conservatively so that it operates at reasonable rates of heat transmission. It has ample combustion space so the firebox temperatures are not too high. It has large water spaces and is not sensitive to feed water conditions. It is easy to clean on both the fire side and the water side. With reasonable attention to maintenance, a firebox boiler used for heating or process work will last for many years. A large percentage of such boilers installed thirty or more years ago are still in service.

The packaged boiler has a higher rate of heat transmission because it has less heating surface, output for output. It has much higher firebox temperatures because the combustion chamber is smaller and the heat release is higher. The inevitable result is faster deterioration. The ultimate in high heat release is the jet engine, short lived and noisy.

Ease of Handling

Because the packaged boiler operates at the limit of its output, it must, for safety sake, be fitted with numerous intricate interlocking controls. If one of these controls locks the burner out, the boiler operator may have difficulty in locating and correcting the trouble.

By contrast, the firebox boiler has fewer and simpler controls with correspondingly less probability of burner lock-out and fewer controls to check if trouble should develop.

Method of Rating

Steel firebox boilers are universally rated according to the rating code of the Steel Boiler Institute which has been the accepted standard in this industry for more than 25 years. This code defines two ratings: the SBI rating and the SBI net rating, and specifies minimum heating surfaces, furnace volumes, and other important requirements which must be met by boilers warranted to carry these ratings. Under the terms of this code, the SBI rating of a boiler corresponds with the estimated design load as defined by the ASHAE and the SBI. The SBI net rating corresponds with the net load as defined by the SBI, the ASHAE, and the HPACCNA. This method of rating and selection of steel firebox boilers is well understood by engineers and contractors and is endorsed by the United States Government through their publication of Simplified Practice Recommendation R157-50 "Steel Firebox Boilers and Steel Heating Boilers (Commercial and Residential Types)". This publication is a counterpart of the SBI code. The method of rating shown in the SBI rating code is also endorsed by the HPACCNA and their well-known "Net Load Recommendations for Heating Boilers" publishes net loads identical to the SBI net ratings cataloged by firebox boiler manufacturers.

The packaged boiler industry does not have a standard method of rating which is accepted by all manufacturers. These boilers may have 5 sq ft of heating surface per boiler horsepower, although many of them have less. Some manufacturers claim large furnaces, or large diameter furnaces, or properly sized combustion chambers, but they do not publish figures.

The square feet steam or EDR ratings cataloged by packaged boiler manufacturers are calculated by dividing the nozzle output, in Btu per hour, by 240. These steam ratings do not correspond with any load which the contractor has estimated and if a packaged boiler is selected with square feet steam rating equal to the estimated design load, the boiler will be badly undersized. The gross, or nozzle, output will correspond with the estimated design load and there will not be any reserve boiler output to

supply the extra heat needed during the warming up or pickup.

It is extremely important for anyone who is comparing boiler capacities to recognize the difference between the rating methods used by firebox boiler manufacturers and by packaged boiler manufacturers. Many packaged boilers have been badly undersized because the men who selected them did not recognize the fact that ratings cataloged for packaged boilers are gross nozzle outputs without the reserve for pickup, which is always included in the SBI ratings cataloged for firebox boilers.

Overload Capacity

In the latest edition of "Net Load Recommendations" published by the HPACCNA, a number of packaged boilers are listed with ratings equal to 20.8 sq ft net steam radiation load per square foot of cataloged boiler heating surface. This corresponds to a net load rating of 4992 Btu per square foot of boiler heating surface. These same boilers are rated in the manufacturer's catalogs on the basis of 33,475 Btu (1 horsepower) per 5 sq ft of boiler heating surface or 6695 Btu per square foot, which as noted previously is the nozzle output. Therefore, these boilers have piping and pickup allowance of 6695 minus 4992 equals 1703 Btu or 34% of the net load rating. Firebox boilers will easily develop nozzle outputs 150% or more of net ratings. Therefore, a firebox boiler selected on the basis of HPACCNA net load ratings will have a nozzle output 12% or more above that of the packaged boiler which has an identical net load rating. (1.50 divided by 1.34 equals 1.12).

A consideration of these facts demonstrates that a packaged boiler listed with any particular net steam radiation load rating will not have as much nozzle output as a firebox boiler listed with the same net stream radiation load rating. The firebox boilers will have more reserve capacity than will be available in the packaged boilers for unexpected overloads or for loads which may be added later or for loads not considered in the original calculations.

Availability of Fuel

Packaged boilers will not operate on solid fuel. They must be fired with oil or gas, because they are designed with very small combustion chambers and because the combustion chambers are long and narrow and not suitable for installation of stokers.

Firebox boilers can be converted for stoker firing without reducing the available output, because they have ample size fireboxes of proper proportions and type to receive stokers, and because the gas passages are suitable for this service.

No one can predict positively what fuel situation will exist thirty years hence or, for that matter, what changes may occur in availability of the various fuels during that period.

For this reason, it is important to select a boiler that can be adapted to operate at its full output with either liquid or gaseous or solid fuel.

Firebox boilers with their generous combustion chambers can and do burn the heaviest fuel oils easily and with good economy. They can also burn the lighter oils and gas. Should liquid or gaseous fuel be unavailable or too high in cost, the units can be converted for stoker firing.

Smoke Stacks

Manufacturers of packaged boilers claim that their boilers can be installed without stacks. The purchaser would be prudent to check carefully before accepting this claim at its face value. In some areas stacks are required regardless of forced draft firing. In every case the products of combustion must be discharged at a point which is safe and not objectionable.

The user of a firebox boiler may have his choice of natural or mechanical draft. In many cases he will prefer natural draft because a stack is available or because the installation is in an area of high buildings where the products of combustion must be discharged above the building in any case or because he does not wish to buy power for the purpose of removing gases. If the user does want mechanical draft, it is readily available in the form of a draft inducer which he may purchase with his boiler or from a fan company.

Space Requirements

Firebox boilers built by various manufacturers do not have uniform dimensions and the same is true of packaged boilers. For that reason, it is not advisable to generalize on space requirements for one type as compared to the other type. However, in general, it will be found that boiler rooms for packaged boilers need to be somewhat longer than would be needed to provide the same clearances for firebox boilers of the same output. Firebox boilers are usually somewhat higher due to their much greater combustion space.

Simplified Definition of Air Conditioning

As a means of clarifying the confused situation as to the proper definition of air conditioning, a new and simplified definition has been prepared and adopted by the American Society of Heating and Air-conditioning Engineers.

The definition, announced by John W. James, president of ASHAE, at the recent semi-annual meeting of the Society which was held in Washington, D. C., reads:

> "Air Conditioning is the process of treating air so as to control its temperature, humidity, cleanliness and distribution to meet the requirements of the conditioned space."

It is the hope of ASHAE that this definition will prove helpful to the public.

LOUIS BLENDERMANN ON

PIPING AND PLUMBING

Storm Drainage System for Flat Roofs

AN important design consideration for every new project is a storm water system that will receive the rain water at roof level in an adequate manner and conduct it to an outside, independent storm sewer, combined sanitary and storm sewer, dry wells, a stream, the curb or other point of discharge. Such systems might be regarded as a simple phase of design, requiring but a minimum of thought and effort. Actually, storm drainage systems require considerable thought and design effort to produce not only the best system for the purpose intended but also one that is economical. Unfortunately, there exists a general tendency among engineers to treat this subject rather lightly.

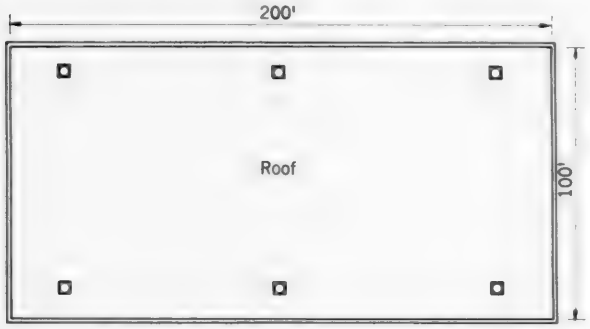


Fig. 1. Typical arrangement of roof drains to afford complete drainage of roof.

Attention is directed in this article to some of the factors that should be considered when the design of a storm drainage system is contemplated. Only flat roofs will be covered at this time.

Rainfall Intensity

The very first factor to be studied in connection with storm drainage systems is the amount and rate of rainfall expected in the vicinity of the proposed project. This information can usually be obtained from the local plumbing authorities or is available in tables on Rainfall Intensity-Frequency Data, as issued by the United States Department of Agriculture. These tables supply rainfall data for areas in all parts of the country.

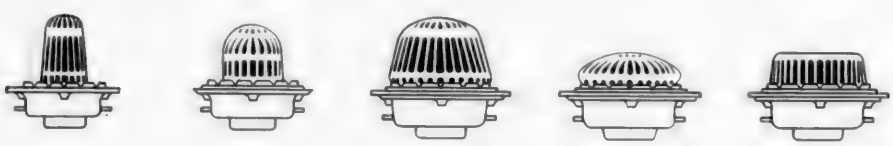
Once the frequency and rate of rainfall has been determined, it is easily applied to the square feet of roof surface to enable the engineer to calculate the diameter of the storm water piping needed. Various tables have been worked out to assist the engineer in his design work. An example of suggested tables that can be used for this purpose are contained in the National Plumbing Code. Local plumbing codes also generally contain helpful tables.

Spacing of Roof Drains

Where should the roof drains be placed on a flat roof? The rainfall tables indicate the diameter of vertical leaders required for a prescribed square foot area of roof surface, based on the prevalent rate of rainfall in inches. A number of drains are needed when small diameter roof drains and leader piping are used. Fewer roof drains are needed as the diameter of the drains and leader piping are increased. Figure 1 represents a typical roof surface and suggests a method of arrangement in roof drains.

Referring to Fig. 1, for which 4 in. diameter roof drains have been used and, it will be noted, are spaced evenly apart. This particular method prevents the accumulation of puddles on the roof after a storm. Even though the roof is flat, there will always be uneven areas on the surface where the water will remain for a number of days until it is dried up by the process of evaporation. With the greater number of smaller diameter drains the occurance of puddles is greatly reduced, and the entire surface is drained rather easily. A lesser number of larger diameter drains will not drain the roof area as thoroughly. The decision on the number and diameter of roof drains to be used rests with the engineer and is based on the specific needs of the project.

Fig. 2. Several of the many types of roof drains available for flat roofs.



Type of Roof Drains

After the number and spacing of roof drains has been accomplished, the next step is to select the appropriate type of roof drain. For flat roofs there are numerous types of drains from which to make a selection. Figure 2 illustrates several of the types commonly used.

Although each of the roof drains shown in Fig. 2 are similar in body construction, the shape of the dome strainer is different. Each of these dome strainers was designed to fit a certain particular need in storm drainage control. We will not attempt to outline the specific advantage to be gained with each type of strainer but will only advise that all of them are suitable for flat roof surfaces.

Regardless of what the special requirements may be, roof drain manufacturers have drains that will satisfy even the most unusual needs. In addition, roof drains can be furnished in one of several materials or material compositions to comply with the wishes of the owner or architect. When necessary, a material can be used to withstand the corrosive action of the impurities found in the air at certain locations.

Retarded Flow Drains

For buildings like industrial plants, warehouses, automobile plants and similar buildings which are rather spread out and occupy acres of ground, the installation of the storm water system can become an expensive construction item. A great deal of thought has been expended on the subject of cost and as a result, great strides have been made in lowering the cost.

One method that has been used with a good deal of success consists of installing roof drains that are undersized for the rain load imposed. The storm water piping is then also undersized in the same proportionate manner. This causes the roof to act as a reservoir for the water during a severe storm. The result is that flow of rain water is retarded and although it will take longer for the roof to drain, a great savings is realized by furnishing small diameter pipe rather than the larger diameter pipe otherwise required. Tremendous savings are accomplished in this manner. Moreover, by prolonging the time needed for the roof to drain, the outside storm system in the street will also benefit from the reduced concentration of rain water flow. This is an important consideration since

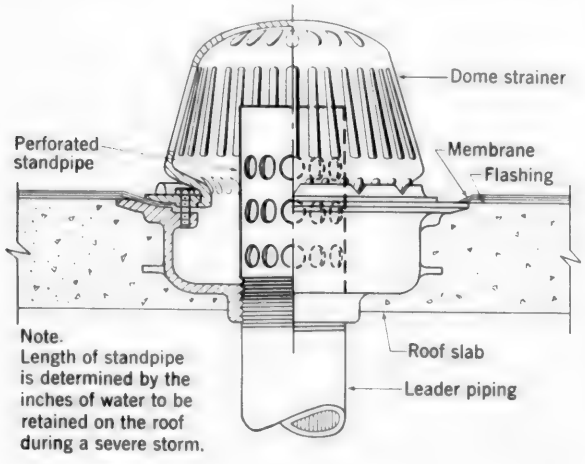


Fig. 3. Modification to a roof drain to provide a retarded flow.

many of the present outside storm systems are undersized and are not adequate for the many new buildings being erected.

Often, it is not desired to limit the capacity of the building storm water system but instead provide a system that is of sufficient size for the prevalent rainfall. If a retarded fall is still required for any reason, it is something relatively easy to furnish. In this method, roof drains of the correct size are used. However, the roof drain will be equipped as shown in Fig. 3.

Section through steel roof deck

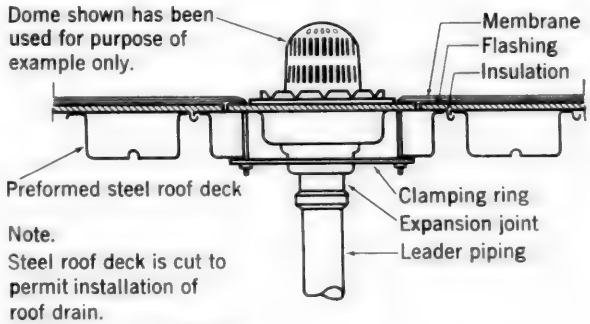

Dome shown has been used for purpose of example only.
Membrane
Flashing
Insulation
Preformed steel roof deck
Clamping ring
Expansion joint
Leader piping
Note.
Steel roof deck is cut to permit installation of roof drain.
Other types of preformed steel roof decking is handled in similar manner.

Fig. 4. Typical installation of roof drain in preformed steel roof decking.

As indicated in Fig. 3, the roof drain is of the regular type generally used for flat roofs, with the exception that a perforated standpipe is inserted into the drain. The purpose of the standpipe is to retard the flow of rainwater discharged into the piping system. If a 6 in. drain is required for the particular area of roof to be drained, then perforations equal to the effective open area of a 4 or 5 in. pipe can be furnished in the standpipe. Depending on the number and size of perforations, any rate of flow can be accomplished.

The roof in this instance also acts as a reservoir for the rain water during a heavy storm. An advantage of the standpipe is that it governs the amount of water buildup on the roof. When the water exceeds the height of the standpipe, it will overflow into the standpipe and is then discharged at a rate for which the size of drain was intended.

If for any reason at a later date, the owner wants the roof drains to function at the rate for which they were sized, it is necessary only to remove the standpipe. This drain also has application on those roofs where it is desired to maintain several inches of water on the roof for cooling purposes.

Roof Construction Materials

Tremendous strides have been made in lightweight roof construction. Concrete slab, concrete planks, and preformed steel decks are some of the many materials available. The preformed steel decks offer the biggest problem as far as the installation of the roof drain is concerned. Figure 4 shows a typical roof drain installation in such construction.

The type of steel roof decking illustrated in Fig. 4. is known as Fenestra. It is used here only for the purpose of example. When preformed steel decking is used, a hole must be cut in it to allow for the installation of the drain. It is recommended that the hole be cut in a strong point

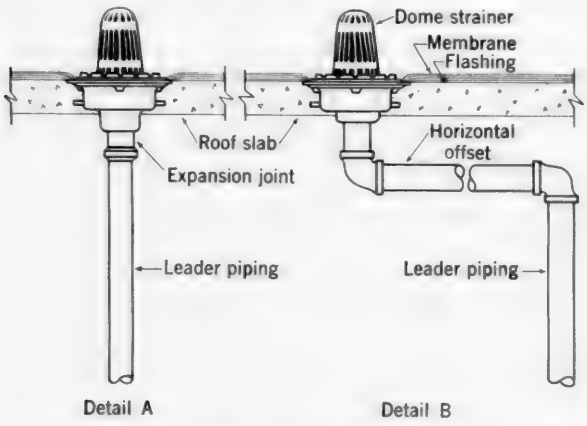


Fig. 5. Suggested methods of compensating for expansion and contraction.

of the decking. When in doubt as to where to provide the hole in any type of preformed steel roofing, it is suggested that you consult either the structural engineer designing the roofing or to check with the manufacturer of the particular material.

For the installation shown, you will note that a clamping ring has been attached to the drain. This ring is tightened against the underside of the formed steel sections to anchor the roof drain securely in place. This modification to the roof drain represents one of the many little refinements that can be added to the drain in order to satisfy the various types of roof construction. Roof drain manufacturers produce many such modifications to render the drain suitable for any condition of installation. Regardless of the type of roofing experienced, there is a roof drain available of the type that can be used for a particular design.

Connections to Roof Drains

Roof drains are equipped with either a caulked or threaded connection depending upon the material used for the piping system. The materials most generally employed for the piping system are cast iron, galvanized wrought iron, galvanized steel or copper tubing as determined by the engineer.

Expansion and Contraction

Expansion and contraction are factors that must be given some attention with storm drainage systems. Most expansion is generally caused by a roof that heaves when it is heated, and contraction when it cools off. When this condition becomes a problem on your project, one of several methods can be utilized to prevent rupture of the roof drain connection. Figure 5. shows two suggested methods.

In most cases, the movement can be taken care of by offsetting the piping from the vertical leader to the roof drain as shown in detail *B* of Fig. 5. This piece of horizontal piping is generally sufficient to compensate for any movement.

Another method is by means of an expansion joint that is an integral part of the roof drain as shown in detail *A* of Fig. 5. This method is used when it is not possible to offset the piping. The sleeve of the joint slides in the direction required to take up the motion. Thus, the danger of rupture to the connection is removed.

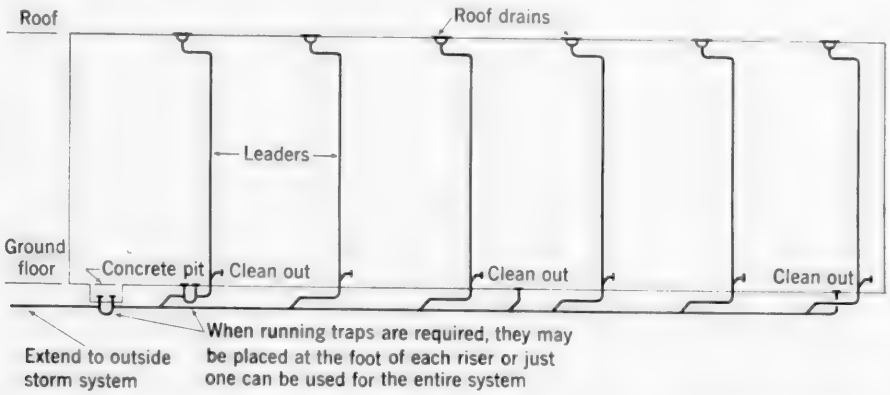
Arrangement of Storm Water Piping

A storm water system is installed as an independent system or is combined with the sanitary system within the building. An independent system is a preferred one, because when the systems are combined and a stoppage occurs in the sanitary system there is always the danger of the rain water backing up and flooding the lower levels of the building.

The system portrayed in Fig. 6. is one for a single story structure used as an industrial plant or for similar buildings. Cleanouts are placed at the base of the vertical risers to clear any obstructions that could cause stoppages at this point. The underground piping is carefully installed and connects with the outside storm system in the street or other point of discharge. Cleanouts are also installed every 40 to 50 ft along the underground line to clear the debris or deposits of sand or grit that often accumulates.

If running traps are required, they are placed either at the foot of each riser or just one trap is installed in the line near the building wall as shown in Fig. 6 to serve the complete system.

Fig. 6. Arrangement of storm water system for a single story building.


Roof
Roof drains
Leaders
Ground floor
Concrete pit
Clean out
Clean out
Clean out
When running traps are required, they may be placed at the foot of each riser or just one can be used for the entire system
Extend to outside storm system

Instrumentation and Control of Boilers

W. G. HOLZBOCK

A better understanding is provided concerning the various phases of instrumentation necessary to secure combustion control. The variables to be regulated may include steam pressure, steam flow, air flow and draft. Responses are designed into the control for specific action and regulation. Not only are the many actions described, but a large number of diagrams help clarify the information which the author has assembled.

COMBUSTION control is designed to maintain minimum fuel consumption, maintain a continuous supply of steam at constant temperature and pressure, and assure safe operation. These conditions must be fulfilled even though the demand of steam, usually called the boiler load, may fluctuate widely.

Air-fuel Ratio

To maintain minimum fuel consumption, the optimum proportion of air must be added. Combustion converts the chemical energy contained in the fuel into heat energy contained in the steam. This conversion requires the admixture of air and the problem is to achieve complete combustion of fuel with a minimum quantity of excess air.

Excess air is objectionable because it carries away useful heat through the chimney, although a certain amount is unavoidable because complete mixture of the air with the fuel cannot be obtained. However, excess air should be limited to 30 to 50%.

Air is added by

1. Natural draft
2. Forced draft fans which are forcing air into the furnace
3. Induced draft fans, located between furnace and chimney, which increases the action of the latter
4. Any combination of the three.

Air flow is controlled by dampers at various locations or by the speed of the fans.

Typical Control System

Figure 1 illustrates a typical combustion control system. The fuel is oil. Four variables are measured, namely steam pressure, steam flow, air flow, and draft. The set point for the steam pressure is manually adjusted. It determines the pressure at which the boiler is to operate.

If the demand load (turbines, heating system, or process) changes, then the steam pressure will tend to change correspondingly. This repositions several dampers and also readjusts the fuel oil flow. The action of these components converges into combustion and the result acts back on the steam pressure as indicated in the diagram.

Furnace draft is measured in order to keep it constant by means of automatically controlled dampers. This is done to limit the amount of cold air which may filter from the outside through the brickwork of the furnace. It also protects from the danger of back firing through the fire door in case of over-pressure in the combustion chamber.

Steam flow and air flow are measured to maintain a constant ratio between the two. A forced draft damper is automatically controlled for this purpose.

All control depends on the steam pressure. Hence this pressure controller is called the master controller.

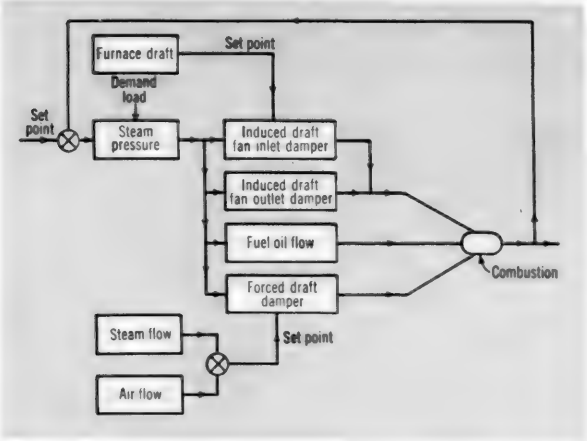


Fig. 1. Schematic drawing of a typical combustion control.

Pressure is the most frequently used master-variable. It is conceivable that other variables like flue gas composition, steam flow, and feed water flow could be used for this purpose. However, the operation of the boiler is not determined by any single one of these variables. For example, steam flow may not increase, but nevertheless the pressure may drop because of other factors than steam demand that combine in the total load on a boiler. These factors may be various forms of heat losses caused by convection, conduction, and radiation from the furnace, and the losses in flue gases. Hence, it appears that pressure gives more complete information on boiler operation than any other variable.

Operation of Control System and Controller

The control system must correct for changes in steam pressure with a minimum of delay. It should make the necessary correction without excessive oscillations of the damper or fuel oil control valve or whatever may be the final control element.

A controller is adjusted for a given value which it is desired to maintain. This is the set point and it may be either manually or automatically set. For example, in Fig. 1 the pressure set point is manually adjusted. The set point for which, however, the induced draft fan inlet damper is positioned becomes automatically modified by the furnace draft.

Deviations from the set point may occur. Although these may be transitory or permanent, both must be kept within acceptable limits. If the controller is not able to operate within these limits, it is not suitable for the job at hand. Another type of controller may then have to be chosen.

A permanent deviation is called offset. It is convenient to speak of the value for which the controller is adjusted as *set point* and of the value which the controller maintains after offset for a given condition is included as a *control point*.

Time Lags

If actions and reactions in a control system and its associated process, for example, the boiler, would take place without loss of time, no control problem would exist. Under such ideal conditions, the steam production of the boiler would increase immediately upon the slightest drop in pressure and balanced conditions would be restored immediately and without difficulty.

These balanced conditions require that input of steam-producing elements corresponds to steam output as required by the load. Practical circumstances require that time be allowed between the change in output, the necessary corrections, and the effect of these corrections.

The first delay occurs due to the fact that a load change is not sensed immediately but after it results in a change of steam pressure. This means that the control system which is intended to keep the steam pressure constant is built on the premise that the steam pressure changes before corrective action takes place. This is an unavoidable contradiction inherent in all automatic control. The art is to keep the change to a minimum. In well-controlled boiler operation, it is generally possible to maintain the steam pressure within plus or minus 1 to 2%, which means that a much smaller change than this is necessary to initiate control action.

The next delay occurs in converting the pressure signal into the changes of position of damper and other final control elements.

The most serious delay, however, is due to the time required to increase the steam output in the boiler. Three main causes produce this delay, namely,

1. Resistances to the flow of heat from the flue gases through the water pipes and the gaseous films around them.
2. Heat capacitance of the water. The more water that is stored in the boiler, the longer will it take before the increased fuel input results in an increased steam output. Modern boilers with relatively small water storage capacity have in this respect, as in others, a great advantage over older types,
3. Side capacitance such as the furnace walls that absorb heat when the boiler output is to be increased and release it when output is decreased. This action corresponds to that of a flywheel which prevents an engine from rapidly responding to a change. Since air-cooled and, particularly, water-cooled furnace walls store less heat, their effect as side capacities is reduced, and control is consequently improved.

Speed of Corrective Action

If the corrective action in a system with time lags would be just enough to bring the system back to its control point after load change, the action would be too slow, the controlled variable which is pressure, would continue to change in the meantime and a control within plus or minus 1 to 2%, as mentioned, would be impossible.

On the other hand, intensifying the corrective action by admitting, after a load increase, more fuel to a furnace than is actually necessary but obtaining thus a faster action, produces overshooting. When the boiler pressure is back at its control point, the excessive fuel admission results in overcorrection. This changes the pressure in a direction opposite to its initial deviation, and the resulting control action will now produce undershooting. Oscillations around the control point are the result.

Stability

Figure 2 shows various forms of responses of a controlled variable to a sudden change in position of the

final control element. The controlled variable may be expressed in pressure, height of level, temperature, etc. The shape of these response curves expresses the stability of the system. In curve *a*, the new value is approached without overshoot, however the time that elapses is long. In curve *b*, the response is considerably faster. There are a few rapidly subsiding oscillations. They are usually acceptable and this form of response is generally considered the most desirable. Curve *c* shows a response of almost continuous oscillations. Needless to say that this is hardly the purpose of automatic control.

The Controller and the Process

The purpose of the controller is to correct for deviations of the controlled variable. Such correction is expected to correspond with graph *b* in Fig. 2. In order to obtain this specific form of response it is necessary to tune the controller to the process characteristics. The process may be the boiler, an air-conditioned room, a heat exchanger or whatever unit that is under control. The characteristics consist of resistances, capacitances, and side capacitances. Sometimes, these characteristics require adjustments that are beyond the range of a specific controller. Since there are various types of controllers and of control actions available, a replacement of the controller may become necessary to obtain optimum control for a specific process. All this requires judgment of the controller and the process in their mutual relationship. Process and controller are combined into an integrated system which is referred to as control loop.

If the fuel admitted to a boiler would control the steam flow, this would be an *open loop* control system. It is hardly ever used but it illustrates the principle of controlling in the flow direction of the system, that is, controlling the output by the input.

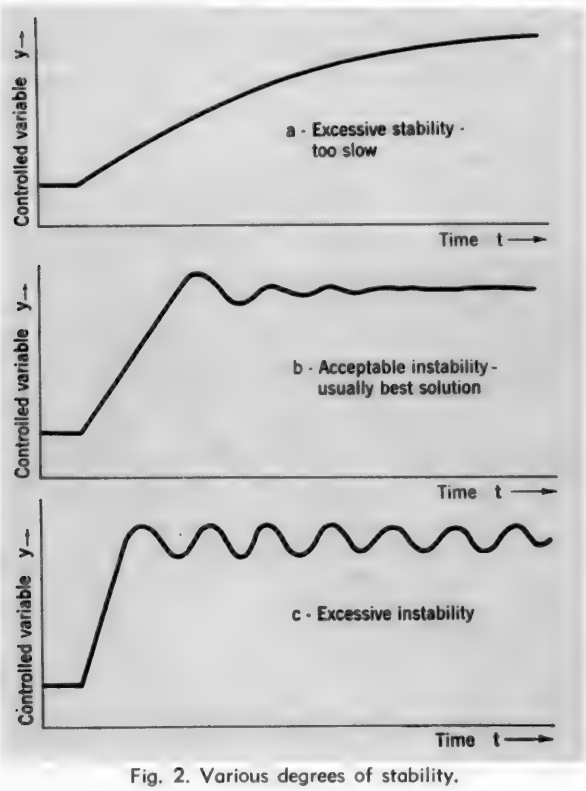


Fig. 2. Various degrees of stability.

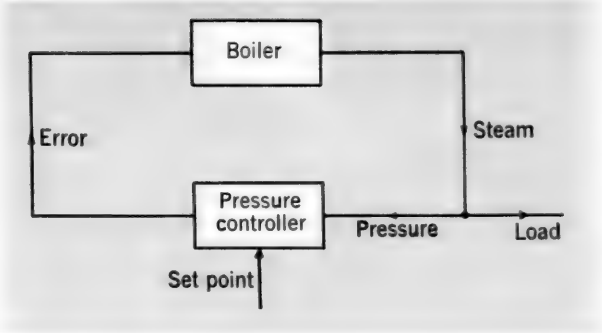


Fig. 3. Closed loop control system.

In the *closed loop* control system, the output controls the input and an interaction of the various elements results such as illustrated by the block diagram in Fig. 3. The pressure controller shown as a block is the master controller. All other controlling elements are considered part of the boiler proper. The output of the boiler is steam and the relative magnitude of the load determines the pressure applied to the controller. Set point and pressure signal are compared by the controller and the difference which is the *error* is the controlling signal that is applied to the boiler in a fashion that may be the same as that illustrated in Fig. 1.

Load Changes

With a steady load on the demand side, the control system should be quiet and the record of the controlled variable should follow one straight line, unless some outside disturbances occur. The latter possibility is ignored for the time being. The controller initiates action when the load changes. These changes may follow any one or a combination of the patterns illustrated in Fig. 4.

The question is how will the pressure controller and the boiler follow such load changes.

Step Function Response of a Boiler

A simple method to determine how a boiler follows a step change, such as illustrated in Fig. 4, consists in simulating this change. Worthwhile information can be obtained by this method as will be shown. Certain prerequisites are necessary to make the test under operating conditions, such as

1. Absence of load changes during the test.
2. No objection to a limited change of steam pressure during the test.
3. Means to record the steam pressure.
4. Automatic-to-manual transfer switch and provision for manual loading of final control element.

The arrangement is illustrated in Fig. 5. The master pressure controller is disconnected and the master signal is manually controlled instead. A sudden manual change of the master signal results in a steam pressure change which is recorded and called the step function response.

It is possible to read from the step function response all the resistances, capacitances, and side capacitances of the boiler in a lump sum, and to determine what control

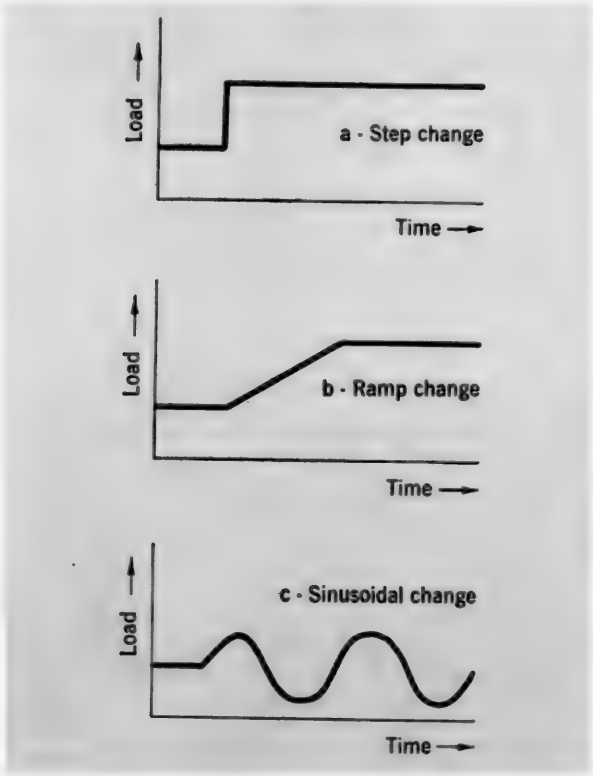


Fig. 4. Patterns of load change.

action is best suited and for what values the various adjustments should be set.

Some basic forms of step function responses are illustrated in Fig. 6. These are highly idealized patterns but they do contain the main components of practical responses. Fig. 6-a illustrates the step input—the sudden manual change of the signal x which under normal operating conditions of the system is the output of the master controller.

Process without Self-regulation

The response of Fig. 6-b is not possible with a boiler installation, mainly because of heat losses in flue gas and through furnace walls. This kind of response is typical of a process which stores up potential energy at a constant rate without altering the energy losses that may occur as an inherent characteristic. A boiler drum may be an example, because if the inlet flow is increased, the level will rise indefinitely as illustrated in Fig. 6-b. A process that responds in this form is said to have no self-regulation.

The rate of response is expressed by the ratio of the response and the time in which this response takes place and it is equal to y/t.

Process with Self-regulation

The response of an actual boiler installation will more likely approach that of Fig. 6-c, although modified by other characteristics that are to be discussed. Figure 6-c expresses that an increase of fuel admission, together with the corresponding amount of air, would increase the steam pressure not indeterminedly but only to a new point of balance, due to the increased losses of heat in all its forms.

Response Rate of the Boiler

The response curve is determined by two conditions, namely the response rate of the boiler and the process gain. The response rate is the change of controlled variable per unit time for maximum step change. It differs from the response speed insofar as the latter term is reserved for the response at any point of the curve for whatever the step change may be. The maximum speed of response is identical with the mayimum slope of the curve or the maximum ratio y/t. While for the process without self-regulation, the ratio y/t is constant throughout, it varies when the process has self-regulation. This is obvious from Fig. 6-c. In this case the maximum is coincident with the point at which the process begins to respond to the step input. The slope of a line drawn tangent to this point, as is done in Fig. 7, would express the speed of response. The response rate is obtained as follows:

In Fig. 5, the step change is a change of the output of the master controller; that is, the master signal. This can be generalized by stating that any controller has an output signal and it is this change of output signal that produces the process response. The output signal of a pneumatic controller is compressed air, generally changing through a pressure range of 3 to 15 psi. Varying it by 2.4 psi changes it through 0.2 times its maximum change. If steam pressure is the controlled variable and if the response curve indicates that upon a step change of controller output of 2.4 psi, the steam pressure changed 100 psi per minute at the maximum slope of the curve, then the response rate of the boiler would be expressed by $100/0.2 = 500$ psi per minute for maximum step change.

Figure 7 illustrates the response of the same process for various magnitudes of step changes in controller output signal. While the maximum speed changes with the magnitude of step change, the response rate is of course the same because it is expressed for the maximum change of controller output signal.

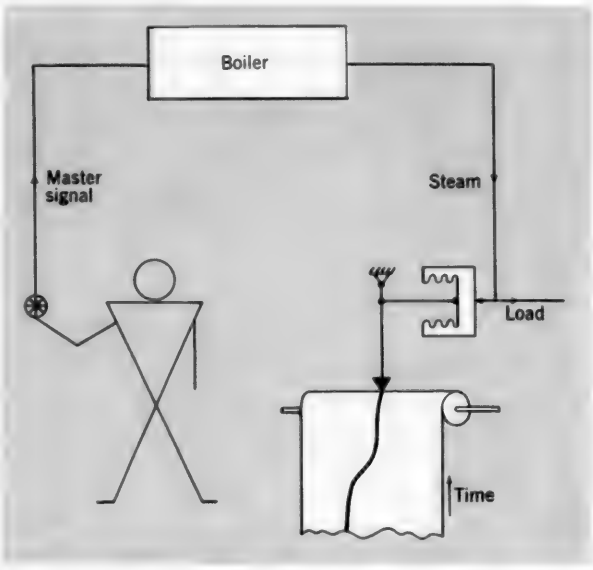


Fig. 5. Boiler step function response.

Process Gain

The second condition to determine the response curve is the process gain. It is the total change in magnitude of the controlled variable that would result from changing the controller output signal through its full range. Thus, if for the same 0.2 change of controller output signal, the steam pressure changes 20 psi, then the process gain is $20/0.2 = 100$ psi.

Designating the process gain by g, and the response rate by c, the two can be combined in what is commonly called the time constant by writing

$$T_1 = g/c$$

Inserting the numbers of the previous example, the result is a time constant of

$$T_1 = \frac{100}{500} = 0.2 \text{ minute}$$

Returning for a moment to a process without self-regulation, it is quite evident that its gain g is infinite, hence its time constant is also infinite.

Other Definitions of Time Constant

Quite frequently, the time constant is defined differently, although its magnitude is always the same. The only difference is that it can be obtained by various mathematical methods. Thus, one definition of the time constant is that it expresses the time which the controlled variable needs to pass through 63.2% of its total change. Since in the previous example the total change is 20 psi, the pressure will change through the first 12.64 psi within 0.2 minutes.

This is illustrated in Fig. 7, together with a graphical method to obtain the time constant. Responses are shown to three step inputs which differ in magnitude. The final levels that are obtained are Y_1, Y_2, and Y_3 respectively. Tangents are drawn to the maximum speed of the responses, and they show that the ratio of the total change of controlled variable to T_1, is equal to the initial speed of response. It is only necessary to multiply this ratio by the magnitude of step input, which may be indicated by r, to obtain the response rate of the process. Thus

$$r_3 \frac{Y_3}{T_1} \quad c$$

and similarly

$$r_2 \frac{Y_2}{T_1} \quad c$$

where r is used with suffixes 3 and 2 to indicate that different magnitudes of step change are involved.

Furthermore, the total change of the controlled variable divided by the magnitude of the step change is equal to the gain. Hence,

$$\frac{Y_3}{r_3} \quad g$$

Substituting this in the previous expression gives the following equation:

$$\frac{g}{T_1} \quad c$$

or it may be stated

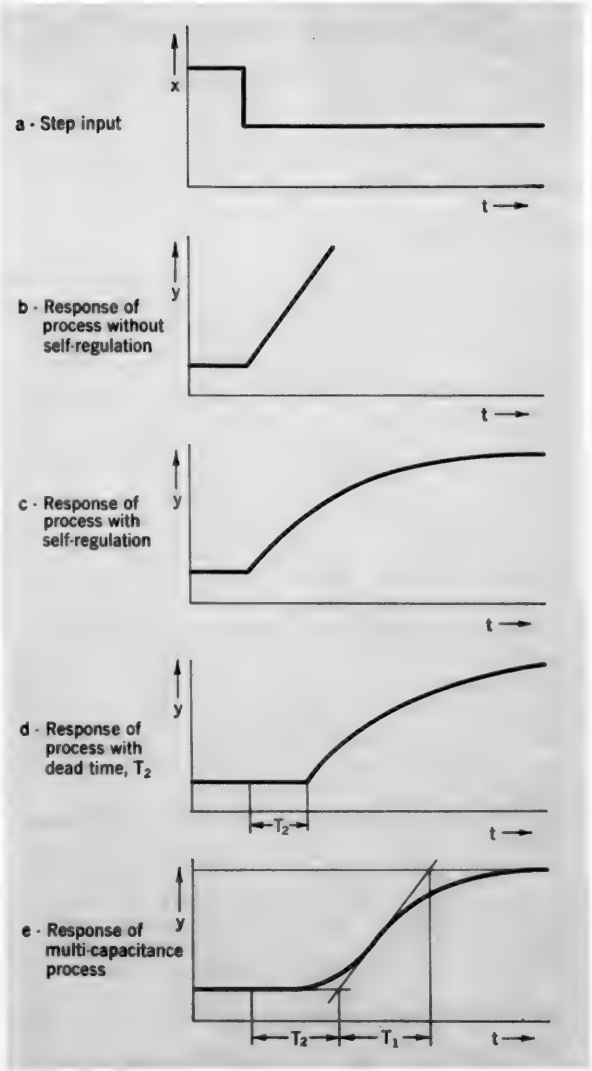


Fig. 6. Patterns of process response.

$$T_1 = \frac{g}{c}$$

which is the same expression for the time constant as was previously obtained, but this time from graphical interpretation of Fig. 7. The same illustration shows that no matter how big the step input is, the controlled variable always reaches 63.2% of its final value within the same amount of time which is given by the time constant T_1.

Using Fig. 7, one can also state that the time constant is obtained from a line which is drawn tangent to the initial speed of response. The time at which this line reaches the final value of the controlled variable is the time constant.

Process with Dead Time

In Fig. 6-d, dead time T_2 enters into the response. Dead time is simply the time that elapses before there is any response. For example, after intensifying combustion in a boiler, some time passes before the generation of steam responds to the change.

Dead time is frequently called distance/velocity lag

(British Standard Glossary) because it is due to the necessity that a change has to be propagated at a certain velocity through a given distance before it can take effect. The widely used term "dead time" is preferred here because of its conciseness.

Dead time plays a most important part in judging the stability of a process.

Multi-capacitance Processes

There is never a single capacitance in a boiler. There is the capacitance in the combustion chamber, that in the boiler tubes, that in the boiler drum. Between the capacitances there are resistances, and the effect of a step change is like a chain reaction where one member after the other enters into the succession of events. The result is a composite curve as shown in Fig. 6-e. Such an S-shaped curve is typical for any boiler and for the majority of processes in general. The sharp distinction between the time constant T_1 and the dead time T_2 is lost. The concept of these two time components, however, is so important, as will be seen later, that an approximation is used which proves to be sufficiently accurate.

It was mentioned that a line drawn tangent to the initial speed of response, Fig. 7, intersects the final value of the time response after time T_1. The initial speed of response in this case was equivalent to the maximum speed of response. In the S-shaped curve of Fig. 6-e, the maximum slope or speed of response is in the bend of the *S*—at the point of inflection. A line is then drawn tangent to the response curve at the point of inflection. The points of intersection with the abscissas of the minimum and maximum values of the response curve are marked. The time between the two points is considered the time constant T_1. The time between the step input and the first of the two points is the dead time T_2.

Step Function Response of a Controller

To make use of the data obtained in the description of the process response, it is necessary to describe various controller actions, such as:

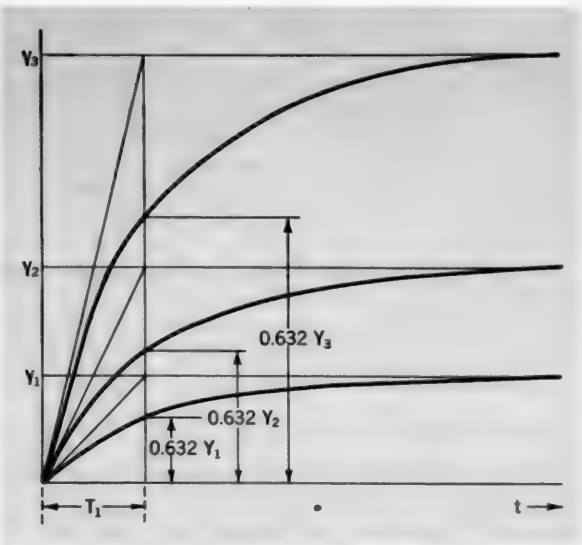


Fig. 7. Step function response of same response with various magnitudes of step inputs.

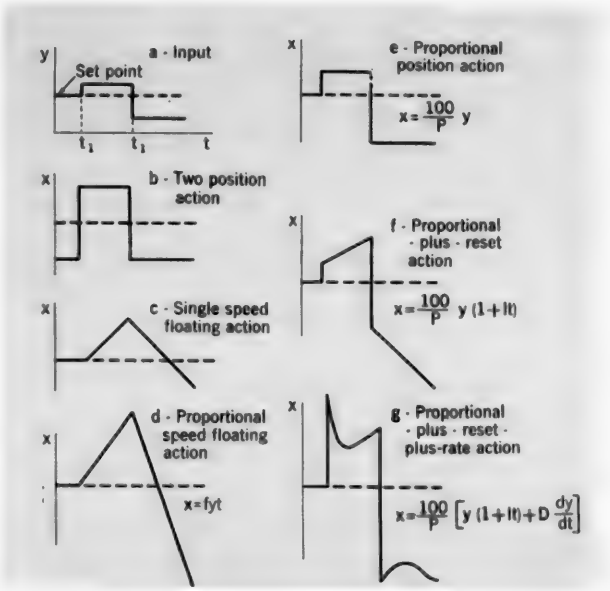

a - Input
Set point
b - Two position action
c - Single speed floating action
d - Proportional speed floating action
x=fyt
e - Proportional position action
x=100/P y
f - Proportional - plus - reset action
x=100/P y (1+It)
g - Proportional - plus - reset - plus-rate action
x=100/P [y (1+It)+D dy/dt]

Fig. 8. Step function responses of controllers.

1. Two-position action
2. Single-speed floating action
3. Proportional-speed floating action.
4. Proportional-position action
5. Proportional plus reset action
6. Proportional plus reset plus rate action

In describing these actions, it is convenient (and in agreement with A. S. M. E. terminology) to consider a final control element, for example, a control valve as part of the controller. The output is then the position of a final control element rather than, for example, the output signal of a master pressure controller. The position is assumed to be linear with the output signal. This is not necessarily so, but the deviation from linearity can only be afforded because control conditions may permit the imperfection. Since linearity can be assumed, this means that the output signal can always be substituted for the position of the final control element, and vice versa.

Some rate of flow is usually the manipulated variable, that is, the quantity regulated by the final control element in order to maintain the controlled variable at its set point. Frequently, the change of position of the final control element is not proportional to a change in manipulated variable. This will be discussed in a later article. It is assumed here that the relation between final control element and manipulated variable is such that the resulting change of controlled variable is proportional to the change of position of the final control element. In a pressure controller, for example, a change of 20% of valve position is assumed to change the flow such that the pressure also changes through 20% of its controlled range.

The step function response of a controller describes the form of its output signal if an input step signal is applied. The responses of different types of control action are illustrated in Fig. 8. Two successive step inputs are applied. Initially the input is equivalent to the set point. At time t_1, the input signal is increased to a new value. At time t_2, a second step is introduced which lowers the input below the set point by twice the magnitude of the first step change. For two-position and single-speed float-

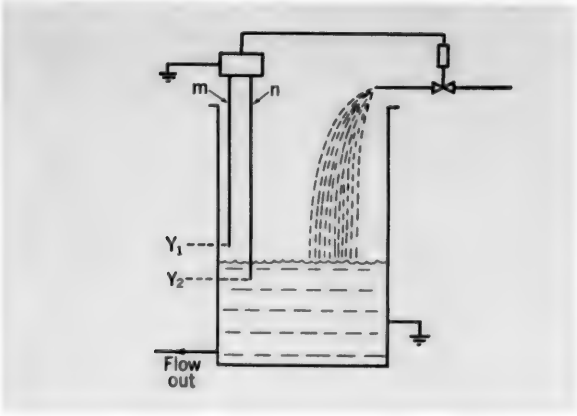


Fig. 9. Liquid level control system.

ing controller, step inputs are of the same absolute magnitude, as will be shown.

The responses are described in the following, under the heading of the respective control actions.

Two-Position Action for Processes without Dead Time

Figure 9 illustrates a liquid level control system. A solenoid valve controls the flow into the tank. The controller includes two metal rods *m* and *n*, which form part of an electric circuit that is closed through the ground connections as indicated. The liquid itself and the tank walls are electric conductors. In the condition shown, the level will rise until it reaches metal rod *m*. At this point an electric relay is energized and locked in that shuts down the solenoid valve. The valve remains closed until the level drops far enough to open the circuit through metal rod *n*. At this point the relay is unlocked and another relay is energized and locked instead to maintain the valve open until the level rises again to *m*. There are only two input signals possible, either calling for flow or not calling for flow. The output, as illustrated in Fig. 8-b is similarly limited to two alternative positions.

The process illustrated in Fig. 9 has self-regulation since the flow out of the tank increases with the height of the level due to head pressure. With the same rate of liquid flowing in, the speed of response becomes slower as the level rises. The process response is hence comparable to Fig. 6-c.

Let the process be started up with an empty tank. The solenoid valve is fully open and the level rises along the process curve *a* illustrated in Fig. 10. On reaching level Y_1, the solenoid valve closes. The level now begins to drop along the inversed process response curve *b*. On reaching level Y_2 the valve opens again. The difference between Y_1 and Y_2 corresponds to the difference in lengths between electrodes *m* and *n* in Fig. 9 and is called the differential gap of the controller.

The smaller the differential gap of the controller, the shorter is the period T in Fig. 10, and the greater is the number of times per minute of opening and closing the solenoid, that is, the frequency of its operation. How large this frequency can be, is largely a question of life expectancy of the solenoid valve, contacts and associate equipment. The frequency can be reduced for a given process by widening the differential gap. This means, however, that the level in the tank will oscillate between wider limits.

Another factor which determines the period T is the process response. A process with a large time constant, that is a slow process, will have a longer period T which is equivalent to saying that the slower the process, the smaller can the differential gap be chosen and hence the closer are the limits within which a process can be controlled, for the same frequency of solenoid valve operation.

Since response curves *a* and *b* express the change of level for a fully open and fully closed valve, respectively, it can be deduced that the response would be slowed down by operating the valve between two positions, for example, ¼ open and ¾ open. High-low or bypass adjustments are usually available with solenoid valves. They allow the setting of any limits between which the valve will operate and thus make it possible to operate within a closer differential gap without changing the frequency of operation. The limitations of this method are given by the magnitude of load change. The maximum consumption of liquid from the tank, for example, should not exceed the flow capacity at maximum opening, while the minimum consumption should not be less than the flow capacity at minimum valve opening.

The period T depends also on the set point of the controller. For example, controlling between levels Y'_1 and Y'_2, Fig. 10, results in a larger period than between levels Y_1 and Y_2. In general, the longest period can be obtained by controlling toward either the upper or the lower level of the tank.

Two-position Action for Processes with Dead Time

Possibly the most frequently used two-position controller is the thermostat. It usually forms part of a room-heating system. The response of such a system is different from a liquid level control system since it involves dead time. While the general considerations of the level control system hold true in any two-position control, the presence of dead time alters some of the conclusions. It changes the response of the system as illustrated in Fig. 11. The graph represents the condition of an initially cold room. The heating system had been cut off for an indefinite time and is started up. If the thermostat contacts were short-circuited, the temperature would rise along the dashed line up to a level which is determined by the self-regulation of the system. If the thermostat cuts the heating system off at Y_2, the temperature will still continue

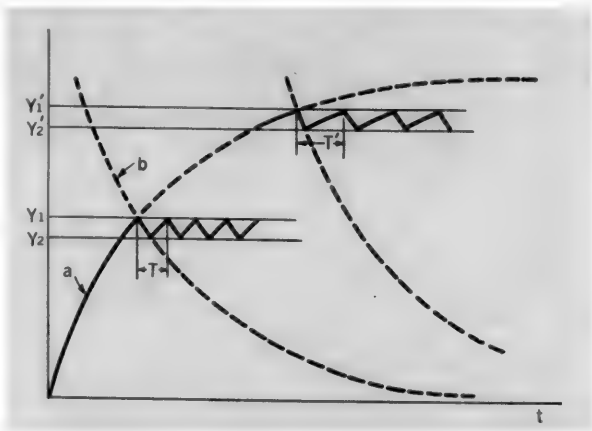


Fig. 10. Two-position control action.

to rise somewhat due to the dead time which delays the effect.

If the time constant is sufficiently long, which means a more gradual slope of the response curve in Fig. 11, then the overshoot is correspondingly reduced and it is hence the *relative* length of dead time, or the ratio T_2/T_1, that is responsible for the overshoot.

The limiting factor for two-position control in processes with dead time is therefore the ratio T_2/T_1 which produces overshooting of the control limits and hence temperature variations that may be of greater amplitude than would be desirable.

There are several methods to reduce this amplitude. The most obvious one is to reduce the differential gap. This has, however, mechanical limitations due to backlash and lost motion. In a bimetallic thermostat, for example, it is hardly possible to reduce the differential gap below 1.5 deg F.

Another method is the accelerator, a heater element in the thermostat which is energized whenever the latter calls for heat. The sensing element, usually consisting of a bimetallic strip, responds to the additional heat of the accelerator and therefore cuts off the heating system before temperature Y_2 is actually obtained in the room. This in effect reduces the differential gap, and hence the overshoot.

A third method, which is frequently used in heat-treating furnaces, consists in operating at a slower heat-producing rate, hence at a longer time constant, when approaching the set point. The higher rate is used for starting up to avoid delays and the lower rate reduces overshoot. A multi-position controller switch automatically changes from one rate to another at a pre-set temperature.

Load Changes with Two-position Action

Figure 12 shows the effect of load changes by means of three curves, namely, the load curve, the curve that shows the position of the final control element, and the curve with the fluctuations of the controlled variable. The controlled variable is assumed to be temperature and the process response is considered to include dead time. The final control element, for example a valve in a steam

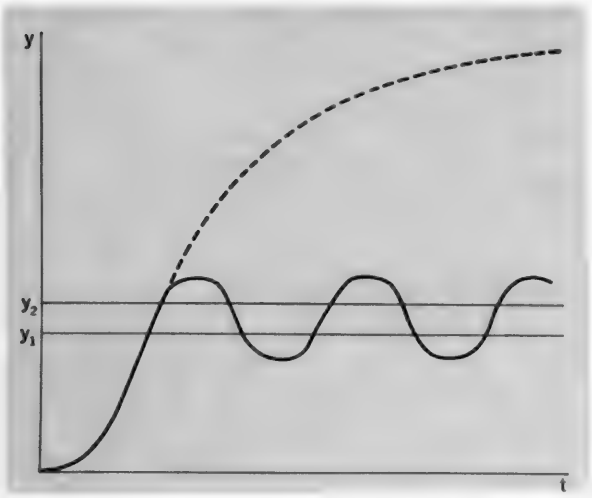


Fig. 11. Two-position control with dead time.

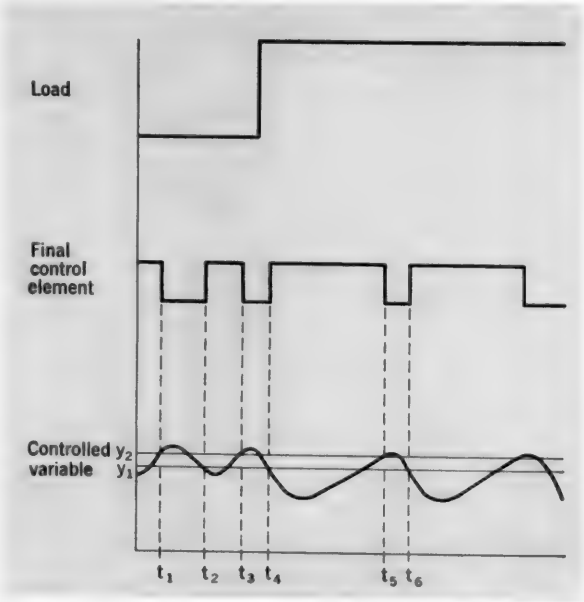


Fig. 12. Effect of load changes on two-position control for process with dead time.

heating system, is shut down when the controlled variable reaches the temperature Y_2 at t_1, however due to dead time there is some overshoot. When the temperature begins to drop, it has to reach Y_1 before the valve opens and again there is some overshoot. The difference between Y_2 and Y_1 is the differential gap.

At t_3 the valve is closed again, but shortly after, a load change occurs that calls for considerably more heat input. Since the valve is closed, the temperature drops at a faster rate than before. This is equivalent to a shorter time constant, and results in a larger T_2/T_1 ratio, hence larger overshoot as expressed in the graph. The temperature finally builds up again, at a slow rate since the load continues to be large and the consequence is that the overshoot between t_5 and t_6 is small. Nevertheless, the amplitude of oscillations has increased considerably.

A similar case could be made for an application that is based on a decrease in load.

Conclusions for Two-position Action

In conclusion the following statements can be made about two-position action:

1. The controlled variable oscillates within a certain amplitude above and below the set point.
2. For a given process and load, the amplitude depends on the differential gap.
3. The minimum differential gap is generally limited by mechanical conditions.
4. In a process without dead time, the minimum differential gap is also limited by the maximum permissible frequency of operation of the final control element. The frequency increases inversely to the time constant of the process. Hence processes with short time constants are not suited for two-position action.
5. In a process with dead time, the overshoot is the limiting factor. For a given differential gap and load, the overshoot depends on the ratio of dead time to time constant (T_2/T_1). Hence, processes with a

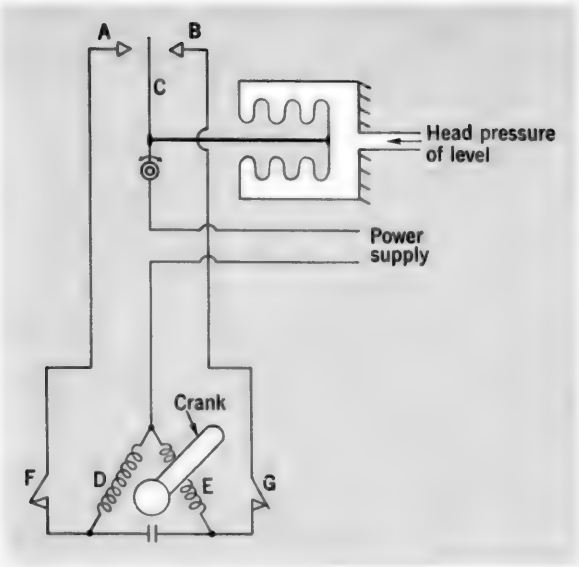


Fig. 13. Single speed floating action.

large T_2/T_1 ratio are not suited for two-position control.

6. A number of remedies are available to improve the response of a two-position controller, such as high-low or bypass adjustments in solenoid valves, accelerators and multi-position controllers.
7. The difficulties caused by overshooting increase with load changes.

In spite of all limitations, there are a great number of conditions in boiler and related control that allow two-position action which results in the most simple and generally the most economical controller.

Single-speed Floating Action

Figure 13 illustrates single-speed floating action. The controlled variable is a liquid level head which is applied as pressure to a bellows. A rise in level will increase the pressure and produce contact between *C* and *A*; decrease in level, contact between *B* and *C*. A certain amount of pressure change may occur around the midposition of *C* without making contact on either side. This range of pressure change is referred to as neutral zone. The motor is a shaded-pole reversible single-phase motor. If winding *D* is energized, it rotates counter-clockwise; if *E* is energized, clockwise—or vice versa. Limit switches *F* and *G* are provided to limit the motor travel to 180 degrees by means of a cam on the motor shaft which actuates the switches. For example, if contact *C* closes on *A*, winding *D* energizes, and the motor rotates counterclockwise until it opens contact *F*, deenergizing winding *D*. No further action occurs until contact *C* closes on *B* and starts the motor in clockwise rotation.

A crank rotating on the motor shaft would be linked to a final control element.

The step function response is illustrated in Fig. 8-c. As long as the input is at the set point, the floating action is zero. As the input decreases, the controller starts to move at constant speed and when the step input is reversed, the motion continues in opposite direction. The absolute speed is always the same.

Single-speed Floating Action and Processes without Self-regulation

Suppose the controller illustrated in Fig. 13 positions a valve in the water line to a boiler drum. If the boiler drum is of equal cross-sectional area throughout its height, and the valve was suddenly opened beyond the requirements of the process, the level would rise continuously. This characteristic expresses the process without self-regulation and its response is illustrated in Fig. 6b.

Let the system be initially in balanced condition. This is shown in Fig. 14 for the case of an ideal controller without neutral zone. Before time t_1, a given load corresponds with a certain valve opening which assures enough water supply to maintain the controlled variable, which is the level at the set point. At time t_1 there is a load change, the steam demand increases and the level drops. From Fig. 13 it can be seen that as a result of this change, contact *C* moves on *B* and energizes the motor which opens the valve to increase the supply as shown in Fig. 14. While *s* corresponds with the supply flow into the tank, *m* represents the rate of liquid removed in form of steam. The valve opens until the supply *s* equals the demand *m*, which occurs at time t_2. However, at this point it is not enough that supply equals demand. As long as the deviation from the set point persists, added supply is required to make up for the deficit in liquid level. The valve will, therefore, continue to open until t_3 at which time the controlled variable recovers the set point. At this point, the valve is open too wide, because the excess of supply to return the level to the set point is no longer needed. The valve begins to close. Until t_4, however, the level continues to rise. It is only then that the valve has obtained the opening *m* which would deliver the required quantity —but at that time the level is too high. Hence the valve goes on reducing the flow until the required level is reached at t_5. At time t_5, however, the situation is the same as it was at time t_1, namely, the supply is not sufficient for what the load demands. The cycle starts again.

The described action refers to ideal conditions only. As soon as dead time is added to these conditions, the response gets worse. Dead time may exist in the process as well as in the controller.

In the following example the controller is assumed to be the cause of the dead time, because the motor of Fig.

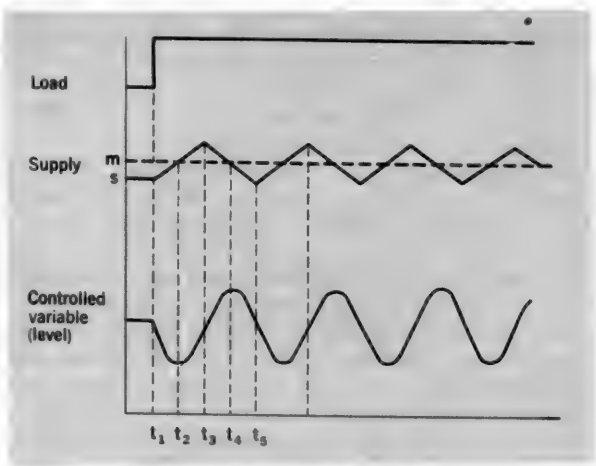


Fig. 14. Process without self-regulation with ideal floating controller (no neutral zone).

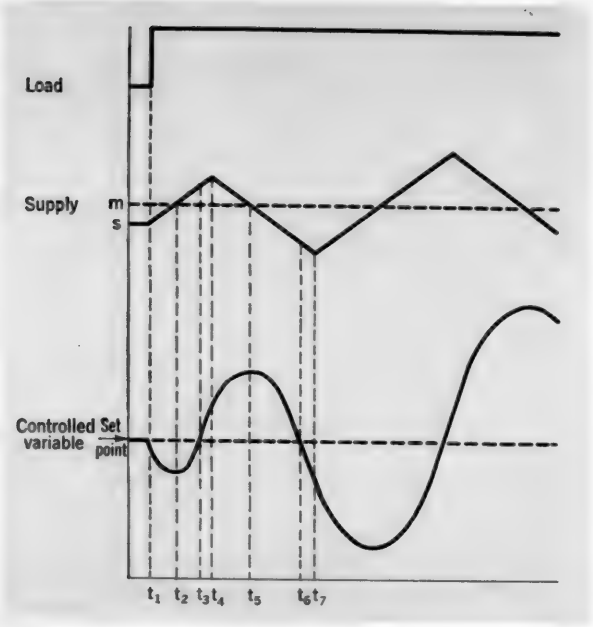


Fig. 15. Process without self-regulation with floating controller (actuating motor coasting).

13 coasts slightly before it reverses. The effect of such coasting is illustrated in Fig. 15. At time t_1 the load increases and the controlled variable begins to drop. Action of the controller gradually increases the supply reaching the m-line at t_2, from which time the controlled variable begins to return to the set point which it reaches at t_3. At this point, the motor should reverse but due to coasting it continues its movement to t_4. The m-line is now crossed at t_5 and an increase of amplitude in the response of the controlled variable is already visible. From t_6 to t_7 the motor coasts again before it reverses and this results in a further amplitude increment. It is obvious that the controller will rapidly reach its maximum amplitude, limited by mechanical conditions, and will continue to oscillate within these amplitude limits. Such control is undesirable, and single speed floating action can therefore not be used with processes without self-regulation.

Single-speed Floating Action and Self-regulation

The previously described situation changes completely when the process contains self-regulation. A typical example is an air-conditioning system.

Suppose the motor actuator of Fig. 13 positions the damper in a duct admitting warm air to a room. The room temperature is the controlled variable and the bellows in Fig. 13 may be considered gas-filled and sealed. On a drop in temperature it contracts and contact *C* moves toward *B*.

If the control was disconnected, and the damper would be manually changed, for example, toward closure, then the temperature would drop. This drop would, however, not continue indefinitely as in processes without self-regulation, but it would level out at a new temperature. This is because with the decrease of room temperature, the heat losses through the walls also become less. The resulting response may be compared with Fig. 6-c, assuming that dead time can be neglected and that the system can essentially be considered as single capacity.

Figure 16 illustrates the action of such a system. At time t_1, a sudden increase in heat demand offsets the balance. The temperature starts to drop and this leads to a gradual opening of the damper and an increase of warm air supply.

As in previous examples, the s-line expresses the position of the final control element, and simultaneously the flow into the controlled system, while the m-line interprets the flow leaving the system, which in the present case is the heat loss from the room. This flow leaving the system is no longer a constant as in Figs. 13 and 14, but becomes a function of the controlled variable. When the temperature drops, the heat loss diminishes, which is expressed in the m-line. Thus, the m-line reflects the oscillating response of the controlled variable. The cross-over of the s-line and m-line indicates the point where the supply is equal to the heat loss. This happens at t_2 and from this moment on the temperature begins to rise. At t_3 the set point is reached and the damper begins to close. The fact that the m-line is no longer straight but is deflected in a direction that shortens the time until m equals s, having thus the effect of a damper, leads to rapidly subsiding cycles. The control system is stable; the process with self-regulation lends itself to control by floating action.

Figure 16 also illustrates the fact that the greater the speed of the damper motor, the sooner will the m-line be reached, and the smaller will be the amplitude of the temperature oscillations. This is true for an ideal system, but dead time and time constant must again be taken into account for practical applications. The magnitude of dead time produces overshoots for reasons quite similar to those illustrated in Fig. 15. The difference is that in the damped response of Fig. 16, the resulting oscillations are not necessarily of increasing amplitude, but may rapidly subside.

The floating action of the controller provides a gradual corrective action. The faster the process response, that is, the shorter the time constant as compared to the floating speed of the controller, the less will it be necessary to move the final control element in order to obtain a measurable change in the controlled variable, and hence the less will be the amplitude of the overshoot. For the same reasons, the time constant of the measuring element should be small as compared with the floating speed of the controller.

This implies rather serious limitations on the floating speed and hence on the speed of correction when load

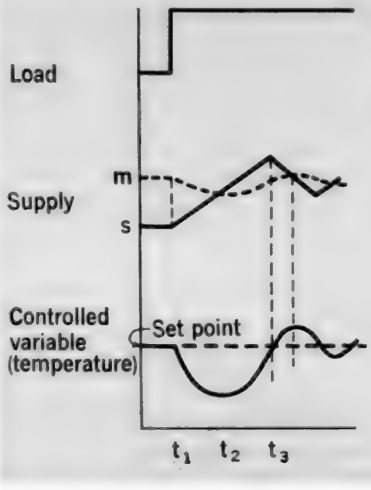


Fig. 16. Process with self-regulation with floating controller.

changes occur. As long as these load changes proceed slowly themselves, the slow corrective action is of minor importance, however if these changes are fast, then the time that elapses before the controlled variable is returned to the set point may become objectionably long.

The conclusions are that:

1. Single-speed floating action can be used only with processes with self-regulation.
2. The smaller the dead time and the time constants, the better is the control.
3. The floating speed, and hence the speed of corrective action, has to be slow relative to the time constants of the process and the measuring means, to keep the amplitude of the oscillations within acceptable limits.
4. The relative slow corrective action permissible with this type of control action becomes more obvious and hence objectionable in processes with fast load changes.

Proportional-speed Floating Action

With proportional-speed floating action, the speed is proportional to the deviation of the controlled variable from the set point. The action of such a controller can be faster by far than that of a single-speed floating controller, because in reducing the deviation of the controlled variable and bringing it back to zero, it automatically slows down the floating speed.

It is used most frequently with hydraulic controllers and thus in boiler installations where not only the advantages of proportional-speed floating action is desirable but also the high power output of hydraulic actuators such as in large dampers and heavy butterfly valves.

The action of a proportional-speed floating controller, which is operating with a so-called jet pipe, is shown in Fig. 17. Oil enters the jet pipe and leaves the tip in a fine stream which is directed toward two receiving orifices. The jet pipe is free to swing in its practically frictionless bearings. It is positioned by a signal system, usually a diaphragm, that converts the controlled variable, for example pressure, into a force that is applied to the jet pipe as illustrated in Fig. 17. This force is opposed by a spring which tries to move the jet pipe in the opposite direction. The resulting position is proportional to the magnitude of the controlled variable.

The receiving orifices are fixed and connect to an actuating cylinder. The piston in this cylinder is linked to the final control element (valve, damper, etc.).

With the jet pipe in mid-position, the oil stream leaving the jet pipe is equally divided between the two receiving orifices; the hydraulic pressure across the piston is equal. Disregarding effects of load on the piston, the latter will stand still in this balanced condition.

If the jet pipe is deflected to the left, as illustrated, the oil stream impinges more directly on one orifice than on the other, the pressure across the piston becomes unequal and the piston moves. Oil, under this condition, is released through the right orifice. The larger the jet pipe deviation, the greater will be the pressure difference across the piston and the faster will it move. This holds true, however, only within the limits of jet pipe deflection from direct impingement over the left orifice to direct impingement over the right orifice. Stops prevent the jet pipe from moving beyond these limits.

The compression of the spring which balances the signal force is adjustable. The amount of compression determines the magnitude of measurement signal required to obtain the mid-position of the jet pipe. This is equivalent to a set point adjustment.

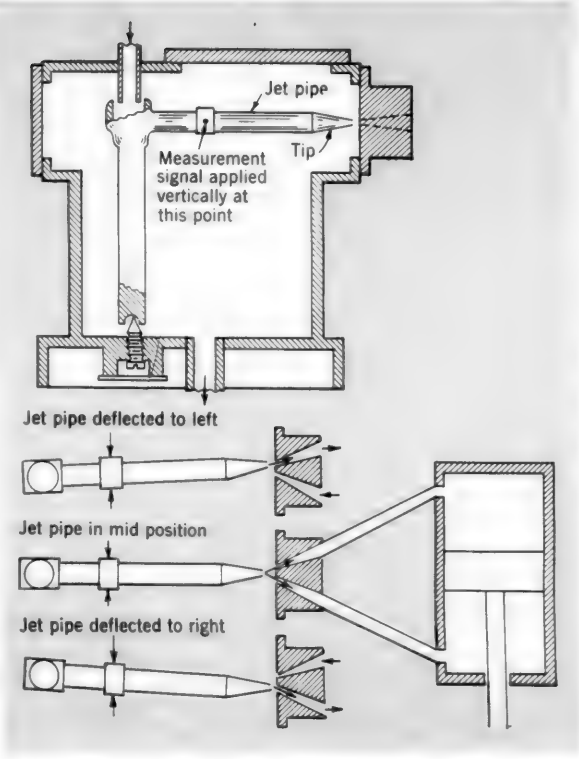

Jet pipe
Tip
Measurement signal applied vertically at this point
Jet pipe deflected to left
Jet pipe in mid position
Jet pipe deflected to right

Fig. 17. Proportional-speed floating action.

Thus the two characteristics of proportional-speed floating action are obtained, namely:

1. The motion of the final control element continues as long as the deviation of the controlled variable from the set point persists or end of stroke is reached.
2. The speed at which the final control element moves is proportional to the deviation of the controlled variable from the set point.

Figure 8-d illustrates the step function response of a proportional-speed floating controller. The ratio x/t expresses the floating speed. It is proportional to the deviation of the input signal from the set point. At t_1 when the input signal increases, the position of the final control element begins to change at a rate which is given by

$$\frac{x}{t} = fy$$

where f is a constant which is called the floating rate of the controller.

At t_2, the step change decreases the input signal such that the absolute magnitude of the deviation is now twice from what it was before. While the floating rate f is a constant, the floating speed x/t increases to twice its previous value.

Figure 18 compares the response between single-speed and proportional-speed floating action, illustrating for the latter, the gradual decrease of floating speed as the controlled variable approaches the set point by contrast with the abrupt change of the single-speed type.

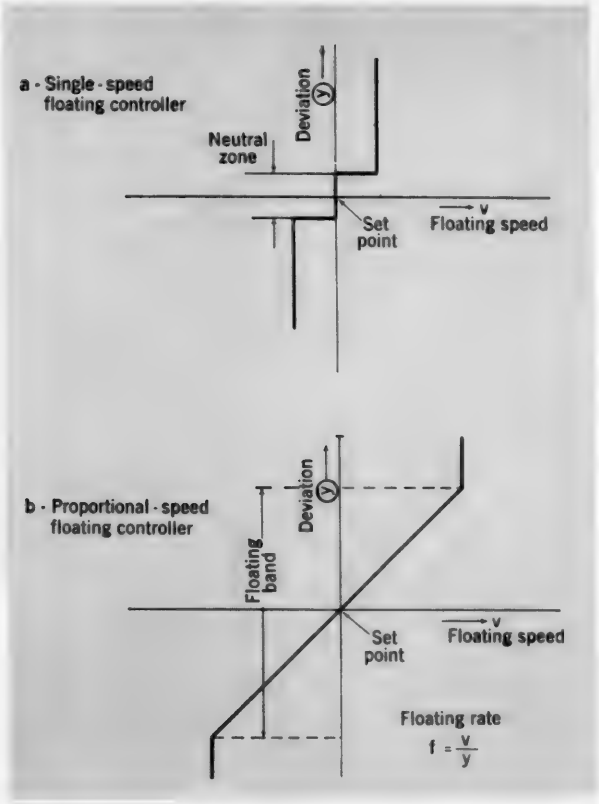


Fig. 18. Floating speed vs deviation of single speed and proportional speed floating controllers.

The speed x/t of the step response is now expressed by v, and hence

$$v = fy$$

The floating speed v is limited by the maximum speed that can be obtained from a given controller. The limits within which the equation $v = fy$ holds true is called the floating band of the controller, as illustrated in Fig. 18. From previous considerations it is obvious that the floating rate should be as high as possible without sustained oscillations. A number of adjustments are available on these controllers to obtain the optimum floating rate.

Adjustment of Floating Rate

For a single-capacitance process, the floating rate f of a controller can be determined from the time constant T_1 of the process and its gain g. The magnitudes may be expressed in any consistent units. For example:

- f = floating rate of final control element in inches per minute per unit change of controlled variable
- g = process gain in units change of controlled variable per inch displacement of final control element
- T_1 = time constant in minutes.

In Fig. 2, three possible forms were shown in which a controlled variable may approach its set point. In the upper diagram the approach is without any overshoot, in the lower one a practically continuous oscillation results. It was pointed out that neither of these two curves represents conditions which are generally desirable, while the center curve is generally considered the best solution.

Curve a results from a floating rate equal to

$$f = \frac{1}{gT_1}$$

A floating rate that exceeds this magnitude will result in some form of overshoot. However, it is possible to increase the floating rate sixteen times and still have not more oscillations than those shown in the center diagram. In this case, each successive overshoot is $\frac{1}{4}$ of the previous one, a characteristic which is generally called $\frac{1}{4}$ decay ratio, and the floating rate is

$$f = \frac{4}{gT_1}$$

This is the equation which should be used in the vast majority of control applications and which will give satisfactory results.

In a multi-capacitance process or one that includes dead time, T_2, the previous rules for adjustment are no longer valid. However,

$$f = \frac{2}{g\ (T_1 + T_2)}$$

should result in good control, provided that $f < \frac{0.6}{gT_2}$

Suppose a tank increases its level by 5 ft when the control valve is opened 1 inch. Hence, the process gain is 5 ft/in. It is further assumed that it takes 4 minutes after this change in valve position until the level increases by 3.16 ft (63.2%), hence the time is to be 4 minutes. The resulting floating rate for $\frac{1}{4}$ decay ratio is

$$f = \frac{4}{5 \times 4} = 0.2 \text{ inch per minute per foot of change in level}$$

On the other hand, a room heating system may have a dead time of 0.5 minute, a time constant of 3 minutes, and a process gain of 6 deg F per inch change in control valve position. In this case

$$f = \frac{2}{6\ (3 + 0.5)} = 0.1 \text{ inch per minute per degree change in temperature}$$

Since $\frac{0.6}{gT_2} = \frac{0.6}{6 \times 0.5} = 0.2$, the condition of $f < \frac{0.6}{gT_2}$ is fulfilled.

These examples show that the proportional-speed floating controller is still rather slow. For example, the temperature control system responds with a floating speed of 0.1 inch per minute to a temperature change of 1 deg. This means that it takes

$$\frac{1 \text{ deg F}}{0.1 \text{ in/min.} \times 6 \text{ deg F/in.}} = 1\tfrac{2}{3} \text{ minutes}$$

before the controller is able to compensate for this temperature change. Although the proportional-speed floating controller is considerably faster than the single-speed type, its inherent lag in corrective action is still large and it becomes a disadvantage, particularly where fast load changes occur.

Proportional-position Action

In the previously described proportional-speed float-

ing controller, the position of the final control element is independent of the deviation of the controlled variable from its set point. As long as the deviation persists, the final control element continues to move—as long as its mechanical limitations allow. In the proportional-position controller, however, the floating speed is infinite. It responds with its maximum action immediately. In this respect, it compares with the two-position controller. The difference is that the maximum response of the proportional-position controller becomes a function of the deviation of the controlled variable, while in the two-position controller the response occurs always between the same two limits.

Proportional-position action is used equally well in electric, electronic, hydraulic, and pneumatic circuits. Figure 19 illustrates a pneumatic application. The signal from the controlled variable is applied as pressure to the signal bellows. An increase of pressure will tend to rotate the flapper clockwise. This brings the flapper closer to the nozzle, decreasing the opening through which air may flow out.

Supply air passes through a fixed restriction and then through the nozzle to atmosphere. Due to the movable flapper, the nozzle tip becomes a variable restriction. The air flow passes through two successive pressure drops, one in the fixed restriction, the other in the variable restriction. The pressure between the two restrictions is the nozzle back pressure and it will assume some intermediate value, which is determined by the flapper position. When the flapper approaches the nozzle, the nozzle back pressure increases. When it moves away, it decreases.

Since relation between flapper position and nozzle back pressure is only linear within relatively small pressure changes and since the flow capacity that can be handled by such an arrangement is rather limited, it is customary

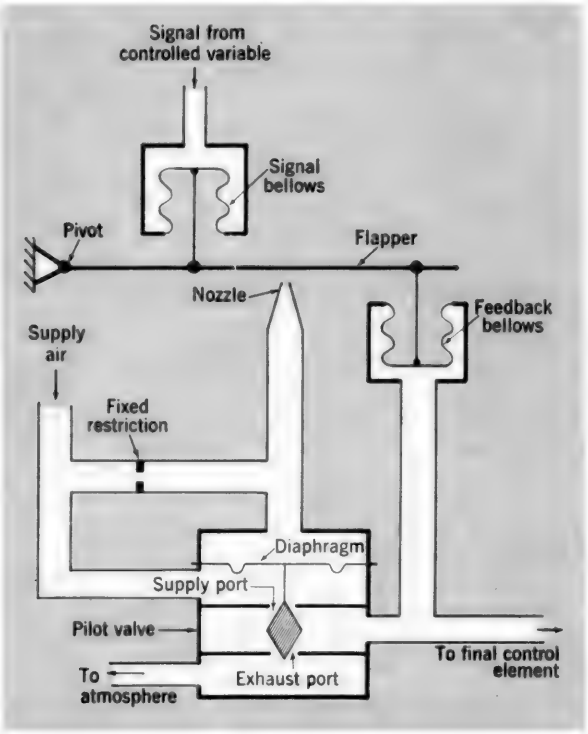


Fig. 19. Proportional-position action.

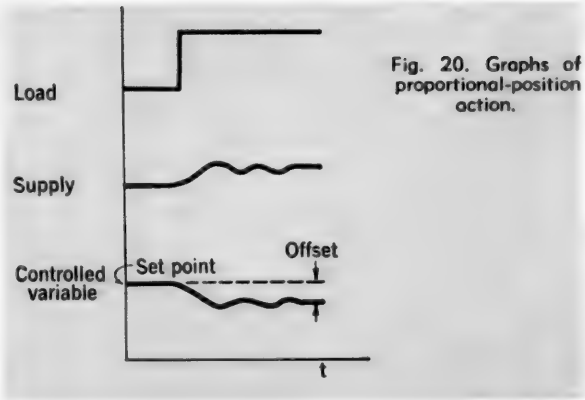


Fig. 20. Graphs of proportional-position action.

to use a pilot valve which increases the effect of the flapper-and-nozzle arrangement. This valve regulates the air flow to and from the final control element.

The nozzle back pressure is applied to a diaphragm in the pilot valve. Connected to the diaphragm is the plug of a three-way valve, which connects the final control element through the supply port to the supply air and through the exhaust port to atmosphere. When the supply port tends to close, the exhaust port opens, and vice versa. Again there are restrictions in series, the supply port and the exhaust port. Both restrictions are variable, and the pressure that exists between them is applied to the final control element.

Suppose the signal from the controlled variable rotates the flapper clockwise, the nozzle back pressure increases, the exhaust port closes, the supply port opens, and hence the pressure between the two ports increases. This increased pressure is not only transmitted to the final control element, but also to the feedback bellows, which now exerts a counter-clockwise force on the flapper. This is the picture of a force balance between signal bellows and feedback bellows. Their balanced position determines the deflection of the balance and hence the signal transmitted to the final control element.

At the final control element, this pressure is converted into a force and balanced with the force of a spring. The result is a finite position of the final control element which is proportional to the signal from the controlled variable.

The described force-balance has been arbitrarily chosen. A position balance is frequently used instead and contrary to a widespread belief there is no reason why the force-balance should be inherently superior to a position balance.

The step function response of a proportional-position controller is illustrated in Figure 8-e. It may be expressed by

$$x = \frac{100}{P} y$$

where P is the proportional band in per cent of instrument range.

The meaning of the proportional band is discussed later in detail.

Offset

The most important limitation of a proportional-position controller is its inability to return the controlled

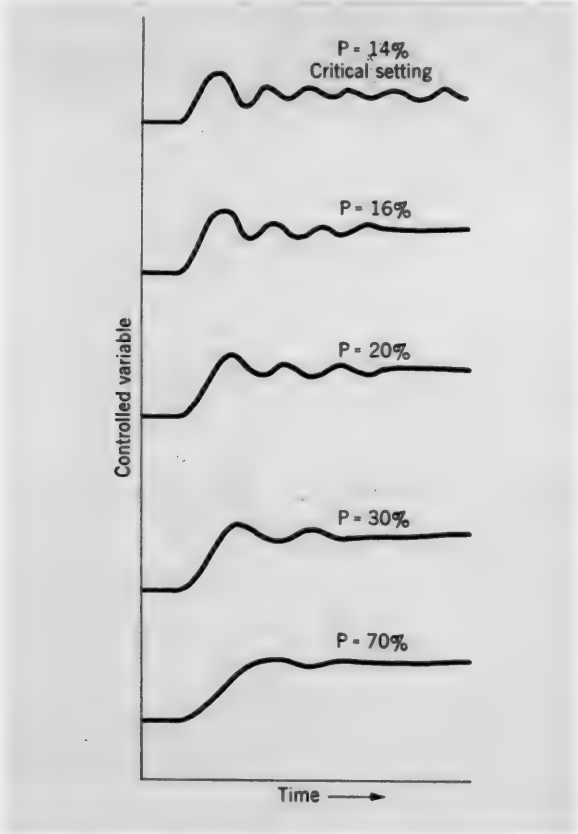


Fig. 21. Effect of proportional-band adjustments.

variable to its set point after a load change has caused a deviation. This is illustrated in Fig. 20. The regulation of the supply, indicated by the center curve, corresponds to the output of the controller. The change in controlled variable expressed by the lower curve represents the input to the controller. Since in the proportional-position controller the output is inversely proportional to the input, their curves must correspond with each other.

After the load change, the controlled variable begins to decrease and the supply rises. Purpose of the increase in supply is to bring the controlled variable back to its set point. However, this is impossible for the proportional-position controller, because its basis is that controlled variable and supply maintain their proportion. The mechanism does not permit one to be maintained at the set point while the other operates at a higher level. The proportional-position controller can only reduce the deviation, but cannot eliminate it. The remaining deviation is called the offset, as shown in Fig. 20.

The quality of proportional position factor can thus be expressed by a factor, which may be called Q, where Q is the ratio between the deviation that would occur without any controller to the allowable offset. W. Oppelt has shown that in order to obtain stable control, the quality of proportional-position control cannot be better than approximately

$$Q = \frac{T_2 + 0.8T_1}{T_2} \qquad (a)$$

For example, a feedwater heater is to raise the feedwater temperature to 180 deg. For a given steam admission this temperature can be maintained as long as a certain average feed water demand from the boiler exists. However, at peak periods, the temperature would drop to 160 deg if the steam were not regulated. Suppose it is desirable to prevent such a decrease in temperature and to limit it to 178 deg by means of an automatic controller. The required quality of control is then

$$Q = \frac{180 - 160}{180 - 178} = 10$$

Let the time constant of the control system be 3 minutes and the dead time 0.5 minute, then it is possible by means of equation (a) to determine if the required quality of $Q = 10$ can be obtained. Substituting numbers for time constant and dead time in Eq. (a) gives

$$Q = \frac{0.5 + 0.8 \times 3}{0.5} = 5.8$$

which shows that the desired quality of control of $Q = 10$ would not be obtained and hence the proportional-position controller would not give satisfactory results.

If it would be permissible to have the water enter the boiler at peak loads with 176 deg, which means to increase the allowable offset from 2 to 4 deg, then the required quality of control is reduced to

$$Q = \frac{180 - 160}{180 - 176} = 5$$

and the proportional-position controller can be expected to render satisfactory control.

Adjustment of Proportional Band

The proportional band is the change of controlled variable necessary to move the final control element through its full stroke. It is usually, as it is here, expressed in per cent of the total measuring range of the controlling instrument. An instrument with total range from 0 to 200 deg may have a 10% proportional band. This means the final control element moves from fully open to fully closed for a temperature change of 20 deg. The proportional band may also be expressed in units of the controlled variable that correspond to the full movement of the final control element. For example, a proportional band of 10 deg means that the final control element moves through its full stroke when the temperature of the controlled variable changes by 10 deg. For smaller temperature changes the movement is correspondingly smaller.

Figure 21 illustrates both the offset and the stability at various proportional band adjustments for a specific process. At $P = 14\%$, continuous oscillations result although offset is at a minimum. A proportional band of 30% is about the most desirable. Under these conditions each successive amplitude is ¼ of the previous and the oscillations are reduced rapidly. The previously outlined criterion for quality of proportional control is based on this kind of response, that is, the ¼ decay ratio.

To determine the proportional band of a recorder controller in operation, the following method can be used, provided the minor upset of the process required for the test is pemissible. The procedure is as follows:

1. Find the widest band required to bring the controlled variable into continuous oscillations, such as the 14% curve in Fig. 21. This setting is called the critical

setting. To obtain it begin by adjusting for a relatively large proportional band, as example, 30%. Displace the set point slightly—just enough to make the recording pen start to respond. Compare the resulting curve with those of Fig. 21. If it is of the same characteristic as, for example, the 70% curve, this mean that 1/5 of 30%, or 6%, would result in the critical response like the 14% curve (which is 1/5 of 70%) of Fig. 21. Similarly, if the shape is more like the 20% curve, it requires a reduction from 30 to about 20% to bring the controlled variable into continuous oscillations. By trying a few band settings, it is possible to find a point where oscillations just begin to become continuous.

2. Once the critical setting is found, double the proportional band. For example, if the critical setting is P = 10%, then the suitable proportional band for the process is P = 20%.

This simple rule, as do all the following, requires certain qualifications. It is based on linearities throughout, but sometimes this is not even approximately true. On a feedwater heater, for example, the temperature may be influenced by the amount of throughput as well as by the steam pressure. Hence the previous test should be repeated by keeping the set point constant and changing slightly the steam pressure. Whichever method results in the wider band, should determine the setting.

This means that the response of the process depends on the nature of the load change.

Another possible non-linearity may exist between the change in position of the final control element and the change in magnitude of the controlled variable. Valves have certain characteristics that relate the lift of the valve plug to the flow through the ports. These characteristics have to match the process in order to change the controlled variable in linear relation to the valve lift. If this ideal condition is not even approximately obtained, then the control system may be stable at one valve position but unstable at another.

There are processes that require an exceptionally fast recovery without more pronounced oscillations being objectionable. In this case the proportional band may be narrowed accordingly.

In other processes, overshoot is most undesirable while speed of recovery is hardly a requirement. This would mean a wider proportional band; however, it would also entail a considerable increase in offset. This will usually be more than can be accepted and a proportional plus reset controller, as described later, may be better suited.

When the dead time and the rate of response of a process are known, the previously described tests are unnecessary. The setting is given by

$$P = c\ T_2$$

or if instead of the rate of response, it is the gain and the time constant that are known, then

$$P = a\ \frac{T_2}{T_1}$$

In these equations, the symbols mean:

P = proportional band in per cent of instrument range (or units of controlled variable).

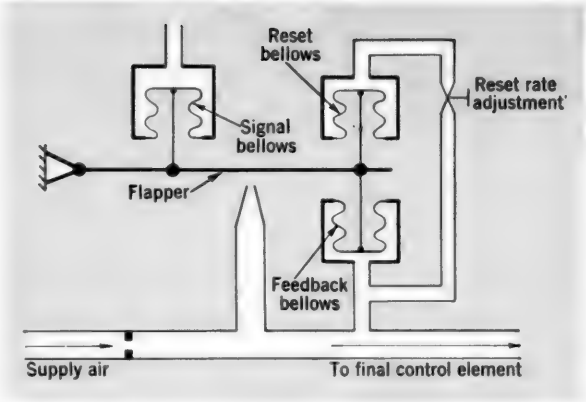


Fig. 22. Proportional-plus-reset action.

a = process gain in per cent of instrument range (or units of controlled variable) per 1% (or inch) displacement of final control element.

c = rate of response in per cent of instrument range (or units of controlled variable) per minute per 1% (or inch) displacement of final control element.

T_1 = time constant in minutes.

T_2 = dead time in minutes.

The results of this adjustment are again such that the resulting oscillations are of the ¼ decay ratio.

Proportional-Plus-Reset Action

The combination of proportional speed floating action and proportional position action is called proportional-plus-reset action. The result of this combination is the elimination of offset. (Fig. 22 illustrates proportional-plus-reset action). The same mechanism as in Fig. 19 is used for this example. The pilot valve, however, is ignored for the sake of simpler presentation. The reset bellows is added.

Suppose that initially the pressure in both the reset and the feed-back bellows is equal and that the pressure in the signal bellows corresponds to the set point pressure. The torques exerted by the three bellows on the flapper balance each other. If the signal increases, the flapper moves clockwise, tending to close the nozzle. This results in an increase of nozzle back pressure which is also applied to the feedback bellows. The resulting position of the flapper, and hence the nozzle back pressure, is thus determined by a new balance of forces excited by the bellows. However, the increased nozzle back pressure gradually leaks through the restriction of a needle valve designated in the illustration as reset rate adjustment. In doing so the reset bellows continue to move the flapper in the clockwise direction which began with the action of the signal bellows. The nozzle back pressure continues to rise in an effort to increase the corrective signal to a point where the controlled variable finally returns to the set point.

The rate at which the air flows through the needle valve depends on the magnitude of the pressure differential across it and hence on the magnitude of the deviation of the controlled variable from its set point.

Figure 8-f illustrates the step function response of a proportional-plus-reset controller. Its mathematical expression is

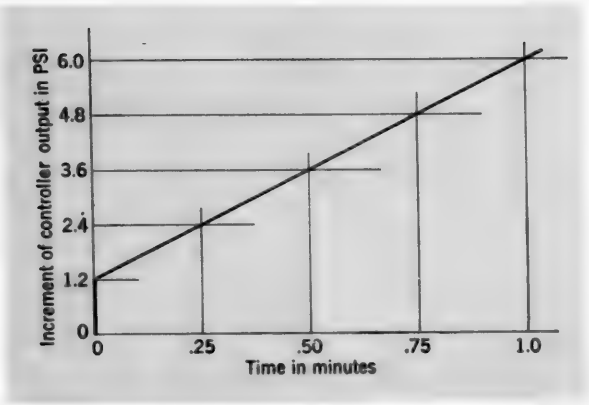


Fig. 23. Proportional-plus-reset action.

$$x = \frac{100}{P} y\ (1 + It)$$

The term $\frac{100}{P}$ y corresponds to the proportional-position action of Figure 8-e. The second term $\frac{100}{P}$ yIt expresses the reset action. This term contains the proportional-position action but multiplies it by the minutes *t*, during which the deviation of the controlled variable persists. It also includes the factor *I* which determines how many times per minute the proportional-position action is repeated by the effect of reset action. It is called the reset rate and expressed in repeats per minute.

Comparing Fig. 8-f with 8-d shows that the floating speed *f* is now replaced by the product of proportional band and reset rate, that is by $\frac{100}{P}$ I, both factors are constants given by the respective adjustments of the controller, but their effect is proportional to the deviation *y* and the time *t*. Reset action is hence nothing but the addition of proportional-speed floating to proportional-position action.

The meaning of the reset rate is further illustrated in Fig. 23. In this case the initial corrective action of a pneumatic controller in response to a given deviation of the controlled variable is an increment of the transmitted pressure of 1.2 psi which is due to proportional-position action only. This corrective action is increased through the effect of reset action by 4.8 psi per minute. Hence the reset rate *I* is equal to 4 repeats per minute.

Suppose this controller has the usual output of 3 to 15 psi which is the range of signals it transmits to the final control element. The corrective action at t = 0 is due to proportional-position action only. It is 1.2 psi or 10% of the output range (15-3 = 12 psi). Hence x = 10% at t = 0.

If the proportional band P = 50%, then at t = 0

$$x = \frac{100}{P} y \text{ or } y = 5\%$$

which means that the response as illustrated was caused by a deviation of the controlled variable from the set point of 5% of the instrument range. Since the reset rate I was stated to be 4 repeats per minute, it follows that after one minute

$$x = \frac{100}{50} 5\ (1 + 4) = 50\%$$

which expressed in psi of controller output change is 6 psi. This is a figure which corresponds with the graph of Fig. 23.

The adjustments of the proportional plus reset controller may again be made either by experiment or by calculations if certain factors are known.

The experimental method follows the steps outlined for proportional-position control. In determining the critical setting of the proportional band at which continuous oscillations begin to appear, the reset action is cut out. The time in minutes, *T*, between two successive maxima of oscillations at the critical setting is measured. The suitable final adjustment of the proportional band is the same as for proportional action alone, that is, twice the critical setting, and the reset rate is

$$I = \frac{1.2}{T}$$

Knowing either the response rate and the dead time, or the process gain, time constant, and dead time, the adjustments can be made by following the expressions in the equations

$$P = c\ T_2 = a \frac{T_2}{T_1}$$

as applied for the proportional controller alone, and

$$I = \frac{0.3}{T_2}$$

which gives the reset rate.

Proportional-Plus-Reset-Plus-Rate Action

The proportional band of a controller can only be reduced to a certain point. Beyond this point the control system becomes unstable. The magnitude of correction of a controller for a given deviation of the controlled variable depends on the proportional band. The wider the band, the smaller and hence the slower is the correction. This delay is a handicap, particularly where the time constant of the measuring element represents an additional delay.

It is desirable in such cases to increase the corrective response of the controller with the magnitude of the deviation. This gives faster response but one which slows down as the controlled variable returns to the set point in order to prevent excessive overshooting and hence instability. Controllers may be provided with rate action which gives the desired result.

Occasionally, proportional action may be provided with rate action only. However, this is rather rare. More frequently the controller in this case includes also reset action and becomes a proportional-plus-reset-plus-rate controller. The reason being that a proportional controller that can operate with a narrow proportional band does generally not require reset action, since the offset is insignificant.

In this case, however, the narrow band provides quick enough corrective response and rate action is hardly warranted. As the band becomes wider, the response is slower, the offset larger, and reset action becomes necessary with rate action added for certain conditions.

HEAT LOSSES FROM BARE PIPE

Heat is lost from pipes by both radiation and convection. The former can be estimated by the Stefan-Boltzmann formula:

$$h_r/A = .174e\left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right]$$

where h_r/A = Btu transferred by radiation per hour per square foot of pipe surface,
e = emissivity of the pipe,
T_1 = absolute temperature of the pipe, F + 460,
T_2 = absolute temperature of the surroundings, F + 460.

Heat transferred by convection can be determined by the Rice-Heilman formula which resulted from work done at Mellon Institute, as follows:

$$h_c/A = C\left(\frac{1}{d}\right)^{0.2}\left(\frac{1}{T_{av}}\right)^{0.181}(t_1 - t_2)^{1.266}$$

where h_c/A = Btu transferred by convection per hour per square foot of pipe surface,
C = a constant with a value of 1.016 for horizontal pipe and 1.394 for vertical plates,
d = outside diameter of pipe, inches,
T_{av} = absolute average temperature of hot body and surrounding air, F + 460,
t_1 = temperature of pipe, deg. F,
t_2 = air temperature, deg. F.

The emissivity in the radiation formula is the "effective emissivity," taking into account the absorbtivity of the bodies receiving the radiation. An emissivity of 0.94 was used in the accompanying table on (oxidized) steel pipe; a value of 0.44 is used for tarnished copper tube and 0.08 for new bright copper.

No convection formula is directly available for vertical pipes. However, the emission can be assumed to be closely approximating that of a steel plate. In this connection, note that C becomes 1.394. In the case of vertical pipes, d in the convection formula is not the diameter of the pipe but the height of the plate (pipe) in inches, in which the value of $(1/d)^{0.2}$ becomes constant when $d = 24$ inches. Therefore, the convection formula for vertical pipe or vertical surfaces becomes

$$h_c/A = 1.39 \times .53\left(\frac{1}{T_{av}}\right)^{0.181}(t_1 - t_2)^{1.266}$$

where the terms are as defined previously.

For vertical pipe, the radiation is the same as for horizontal pipe.

The tables are based on the assumption that the outside surface of the pipe is the same as that of the fluid flowing in the pipe; this is not strictly true, but is close enough for all practical estimating purposes.

Also the tables assume an air temperature of 70 deg. and, in the case of radiation, a temperature of 70 deg. for the surrounding walls, machinery, etc. It can be seen, then, that if the surroundings are at temperatures appreciably above or below 70 deg., the heat transferred by both radiation and convection would be appreciably lower than or above, respectively, the values given in the tables. Consequently, the tables should not be used for cases where the air temperatures and surrounding bodies' temperatures are lower than 60 deg. or higher than 80 deg.

The convection formulas are both based on free convection with no appreciable air motion from fans or open doors; in other words, the tables apply to "still" air conditions.

In the formula for radiation, values for e other than those given for steel and iron pipe and copper tube are:

Surface	Emissivity e
Aluminum, polished	0.08
Aluminum paint	0.40
Brass	0.05
Cast iron	0.20
Lead	0.08
Nickel	0.06
Paint	0.94
Tin	0.08
Non-metallic surfaces	0.90

Small iron pipes of ½ inch size, frequently left uninsulated, can be profitably painted with aluminum paint which, with little effort, serves to reduce the emissivity of the pipe and, consequently, the loss by radiation.

Although the emissivity of copper pipe is substantially lower than that for steel pipe, so that the radiation loss is less, the convection loss is the same for copper as for iron where the conditions are the same. Therefore, it is not true that there is no reason to insulate hot lines because they are made of copper.

Many tables are available on heat losses from bare pipe; most of them, however, are on the basis of either "Btu per square foot of pipe surface per hour" or "Btu per lineal foot of pipe per degree temperature difference (between pipe surface and air) per hour." Note, then, that the accompanying tables are in Btu per lineal foot per hour, with no additional calculation necessary.

HEAT LOSSES FROM BARE STEEL PIPE

HORIZONTAL PIPES

Diameter of Pipe, Inches	Temperature of Pipe, Deg. F.										
	100	120	150	180	210	240	270	300	330	360	390
	Temperature Difference, Pipe to Air, Deg. F.										
	30	50	80	110	140	170	200	230	260	290	320
	Heat Loss per Lineal Foot of Pipe, Btu per Hour										
½	13	22	40	60	82	106	133	162	193	227	265
¾	15	27	50	74	100	131	163	199	238	280	325
1	19	34	61	90	123	160	199	243	292	343	399
1¼	23	42	75	111	152	198	248	302	362	427	496
1½	27	48	85	126	173	224	280	343	410	483	563
2	33	59	104	154	212	275	344	420	503	594	692
2½	39	70	123	184	252	327	410	502	600	709	827
3	46	84	148	221	303	393	493	601	721	852	994
3½	52	95	168	250	342	444	556	680	816	964	1125
4	59	106	187	278	381	496	621	759	911	1076	1257
5	71	129	227	339	464	603	755	924	1109	1311	1532
6	84	151	267	398	546	709	890	1088	1306	1544	1806
8	107	194	341	509	697	906	1137	1391	1671	1977	2312
10	132	238	420	626	857	1114	1399	1714	2060	2437	2852
12	154	279	491	732	1003	1305	1640	2009	2415	2860	3346
14	181	326	575	856	1173	1527	1918	2350	2826	3347	3918
16	203	366	644	960	1314	1711	2149	2634	3168	3753	4395
18	214	385	678	1011	1385	1802	2266	2777	3339	3958	4635
20	236	426	748	1115	1529	1990	2501	3066	3690	4373	5123

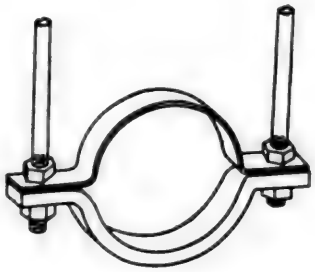
VERTICAL PIPES

Diameter of Pipe, Inches	Temperature of Pipe, Deg. F.										
	100	120	150	180	210	240	270	300	330	360	390
	Temperature Difference, Pipe to Air, Deg. F.										
	30	50	80	110	140	170	200	230	260	290	320
	Heat Loss per Square Foot of Pipe Surface, Btu per Hour										
½	11	20	35	52	71	93	116	142	170	201	235
¾	14	25	44	65	89	116	145	177	213	252	294
1	17	31	55	81	111	145	181	222	266	315	368
1¼	22	39	69	103	141	183	230	281	337	398	465
1½	25	45	79	118	161	210	263	321	386	456	532
2	31	56	99	147	201	262	328	401	481	569	665
2½	37	68	120	178	244	317	397	486	583	687	805
3	46	83	146	217	297	386	484	592	710	839	980
3½	52	94	166	248	339	440	552	676	810	958	1119
4	59	106	187	279	382	496	622	760	912	1078	1259
5	72	131	231	344	472	612	768	939	1126	1331	1555
6	86	156	275	410	562	729	915	1119	1342	1587	1853
8	112	203	358	534	731	950	1191	1456	1747	2065	2412
10	140	254	447	667	913	1186	1487	1818	2181	2578	3012
12	166	301	530	790	1081	1404	1761	2154	2584	3054	3567
14	195	354	624	930	1273	1653	2073	2536	3042	3596	4200
16	221	400	705	1051	1438	1868	2343	2865	3437	4063	4745
18	234	425	748	1115	1526	1982	2486	3040	3648	4311	5036
20	260	472	831	1239	1696	2203	2763	3378	4053	4791	5596

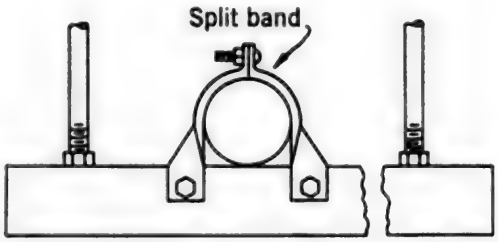
METHODS FOR SUPPORTING PIPE

Pipe Hangers Approved for Use in Government Buildings

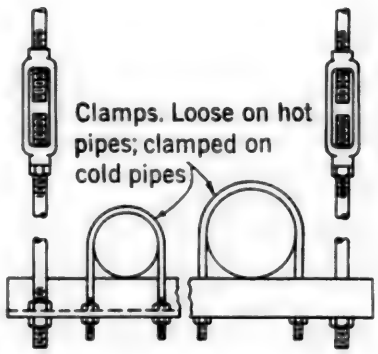
Left, hanger with heavy steel rings for use with pipes carrying steam at 15 psi and over.
Right, support for low pressure steam lines, or water, gas, waste and vent lines.



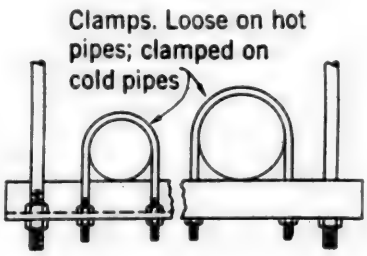
Hanger for jobs where space will not permit the use of adjusters or turnbuckles.



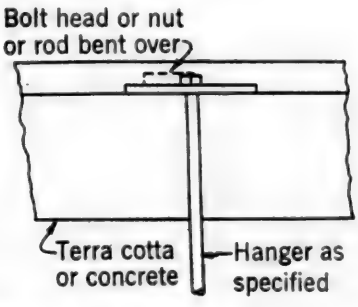
Split band hanger with rod supports.



Hanger using turnbuckle for adjustment. Pipe clamp is made of ¼ in. round iron.



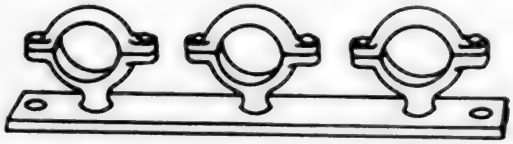
U - clamps used with threaded rod support. Clamp is tight on cold pipe.



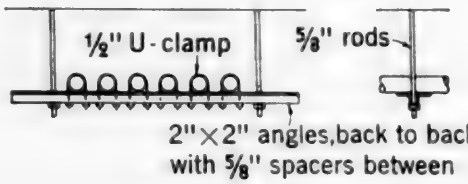
Hanger for use with terra cotta and concrete floor construction.

METHODS FOR SUPPORTING PIPE

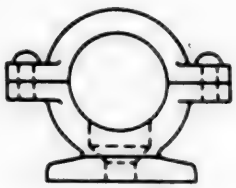
Solid ring hangers with wall plate.



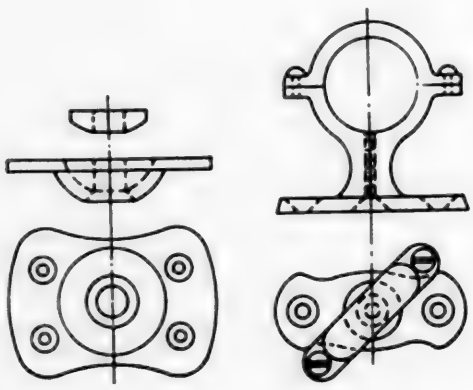
Split ring hangers with wall plate.



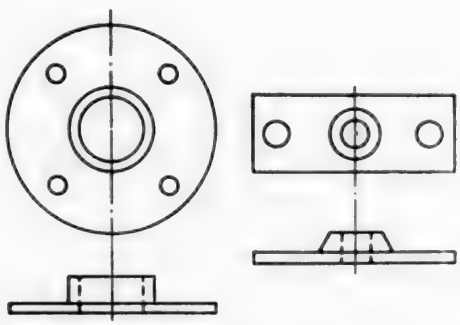
Group type hanger with angle irons bolted back to back and spacers between to permit the use of U-type clamps to secure individual pipes.



Concealed screw or electrician's hanger to support pipe close to a wall.



Left,button type swinging hanger flange for supporting lines form sloping ceilings.
Right,swivel base hanger for supporting pipe at an angle



Where piping is to be supported a distance below the ceiling,either round or rectangular flanges are used to hold the hanger.

Drawings Presented through Cooperation
of J. E. York, S. Weymouth, Mass.

Below and on the following pages are given brief digests of the advertisements appearing in this month's issue. Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail the prepaid postcard to request further information from manufacturers.

The items appear in the same order as the advertisements to which they refer to facilitate obtaining further information after reading an advertisement.

NOTE: All advertisements are digested here except those received too late for inclusion. The Index of Advertisers lists all the advertisements in this issue.

Use the postcard below for catalogs, new equipment and materials, as well as Ad-Digest items.

ROOF VENTILATORS. Page 1. Roof ventilators are offered by this company for any air or fume exhaust problem. Centrifugal and vertical discharge models are available as well as models for industrial air removal and hot, flammable, corrosive fume removal. Bulletins are available. ----------**Item 102**

CONDENSING UNITS. Page 9. A complete line of air conditioning condensing units is offered by this company with sizes from ¼ to 100 hp and self-contained units from 3 to 10 hp. Air-cooled condensing units are also available for outdoor installations. Information is available. ..**Item 103**

CONVECTOR-RADIATORS. Page 11. Fin-and-tube, convector-radiators that are installed at the sill or wall perimeter are made by this company to provide protective comfort along the cold front of a living or working enclosure. They are encased to look more like furniture than heating equipment. Publication is available. ----------**Item 104**

LINE OF PUMPS. Page 13. A line of pumps is offered by this company that features quiet operation, low inlet connections, and accessibility for inspection. A bulletin on each type pump in the line is available. ----------**Item 105**

SOUND CONTROL. Pages 14-15. A 5-ft sound trap replaces 80 ft of ordinary duct lining for controlling air conditioning noise. The units suppress sound in low velocity air conditioning systems and will silence an entire system or selected outlets. Information is available.....**Item 106**

AIR CONDITIONING LINE. Page 16. The line of air conditioning equipment made by this company includes evaporative condensers and cooling towers to 100 tons, condensing units to 100 tons, packaged units to 50 tons, packaged liquid chillers with room console units, and packaged air-cooled units for residential and commercial applications. Information is available. ----------**Item 107**

AIR HANDLING UNITS. Page 17. Over 100 of this company's air handling units help provide quiet service at a hospital clinic. In addition to its fans the company makes vent sets, spray coil dehumidifiers and air conditioning cabinets, lowboy unit heaters, and heating and chilled water coils. Information is available. ----------**Item 108**

DUCT LINING. Page 18. A single piece of this company's glass fiber duct liner can be cemented to metal and formed in the brake. The liner requires no precision cutting or fitting. It is available for low, normal, and high velocities. Information is available. ----------**Item 109**

AIR DISTRIBUTION EQUIPMENT. Pages 19-20-21. This company's equipment was installed to handle the air distribution requirements of New York's Coliseum. Two of its temperature mixing units on each floor supply blended portions of heated and cooled air. Its low pressure diffusers and supply and return grilles are used in the building's system. Information is available. ----------**Item 110**

AIR FILTERS. Page 22. Air filters efficiency graphs are discussed by a filter engineer. The company gives filter test data according to the procedure adopted by the Air Filter Institute. Information on air filters, silencers, spark arresters, oil separators, and liquid and grease filters are offered. Information is available. ----------**Item 111**

AIR CLEANER. Page 23. The filter medium of these air cleaners carries a permanent, electrostatic charge that attracts and captures fine dirt particles. It also permits depth-loading and can be maintained by washing. The air cleaner can be used with any forced air heating or cooling system using panel filters. Details are available. ----------**Item 112**

HEATING-COOLING EQUIPMENT. Pages 24-25. A line of heating and cooling equipment is offered by this company which includes horizontal and vertical discharge unit heaters, convector radiators in floor, wall hung and recessed models, radiant baseboards, and warm air baseboards. An illustrated booklet is available. ..**Item 113**

PACKAGED BOILERS. Page 26. Packaged automatic boilers are made by this company in sizes from 20 to 500 hp with a guaranteed 80% efficiency. Refractory baffles and brick work are not required. Bulletin is available. ----------**Item 114**

VACUUM HEATING PUMPS. Page 27. Vacuum heating pumps are manufactured by this company in single and duplex models with capacities from 2500 to 65,000 EDR. The pumps do not require extensive maintenance and need no close clearance adjustment. Pump literature is available. ----------**Item 115**

BLOWERS. Page 28. Four of this company's blowers operate quietly and efficiently in the finishing department of one of the nation's most modern production plants. They were designed for economical, dependable performance in extreme heat. The company offers the same service to others. Bulletin is available. ----------**Item 116**

MECHANICAL AIR FILTER. Page 30. A mechanical air filter, with 28½ sq ft of filtering area, made by this company, was selected for Denver's Mile High Center. The unit had a renewable media and measures 2 ft x 2 ft x 8 in. Bulletin is available. ----------**Item 117**

INQUIRY CARD

Circle below item numbers on which you wish catalogs or further information.

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168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184					

PLEASE PRINT Aug. H-56

This service available only to U. S. and Canadian readers.

Name .....**Title** .....

Firm .....

Nature of Firm's Business.....

Street .....

City .....**Zone**.....**State** .....

This card is void after Nov. 1, 1956

Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

Ad-Digest

BOILERS. Page 31. Steam or hot water boilers are offered by this company for heating or processing in sizes from 15 to 600 hp and from 15 to 250 psi. They have four-pass design, hinged doors front and rear, and centralized automatic controls. Bulletin is available. ----------**Item 118**

CIRCULATING PUMPS. Pages 32-33. Circulating pumps are designed by this company specifically for quiet operation in liquid heating and cooling systems. The pumps have sleeve bearings, ring-type motor mountings, self-aligning couplers, mechanical seals, and a removable bearing frame for easy servicing. Information is available. ----------**Item 119**

STEEL PIPE. Page 34. Control of chemical composition in this company's pipe is the first requirement assuring maximum weldability. Clean beveled ends, uniform wall thickness and diameter means the ends line up well. Information is available. ----------**Item 120**

CAST IRON BOILERS. Page 35. Two of this company's boilers were only slightly damaged by a Northeastern flash flood last year. The boilers have rapid steaming and high capacity, low maintenance, and are convertible from one fuel to another. Information is available. ----------**Item 121**

AIR CONDITIONING UNITS. Page 36. Packaged units or central systems are available from this company in capacities from 3-hp to a plant requiring thousands of tons of refrigeration. Air conditioning estimates are offered. ----------**Item 122**

REFRIGERANTS. Page 37. A line of refrigerants is offered by this company that is low in moisture content and interchangeable with comparable fluorinated hydrocarbon refrigerants produced by other manufacturers. A folder with pressure and temperature charts is available. ----------**Item 123**

GATE VALVES. Page 38. Gate valves are made by this company with bronze or nickel alloy wedges. Bronze gate valves are available with Monel seat rings for 200 and 300 psi. The line of valves offers different patterns. Information is available. ----------**Item 124**

HOT WATER STORAGE HEATERS. Page 39. One of this company's hot water storage heaters supplies 330 gph of 140 deg F water to the new Air Force Texas radar tower. The company offers a full line of hot water storage heaters, convertors, and instantaneous heaters. Heat exchanger catalogs are available. ..**Item 125**

AIR CONDITIONING SYSTEM. Page 40. Air conditioning systems offered by this company enable designers to specify exactly the type of air conditioning their clients need. It provides individual room air conditioning when needed and means less installation time and cost. Information is available. ----------**Item 126**

WATER LEVEL CONTROLS. Page 41. A line of water feeder cut off combinations is offered by this company to guard against low water levels in boilers. Combinations are available for steam boilers from 25 psi to higher pressure boilers up to 75 psi for both steam and hot water heating. Catalog is available.....**Item 127**

ROOF FAN. Page 42. Roof fans with hinged, circular spun hoods and fan venturi with a directional baffle are available from this company with direct drives from 400 to 34,000 cfm or with belt drives from 4000 to 20,150 cfm. Catalog with specifications is available. ----------**Item 128**

COPPER TUBE. Page 43. This copper tube fabricator's distributors like the service which they get from mill to distributor to contractor. The company's service eliminates delays and speeds delivery of its copper tube. Information is available. ----------**Item 129**

COPPER TUBE AND PIPE. Page 47. A standard of continuous quality control—from raw material to finished product—has been developed by this manufacturer for its copper tube and pipe. A nationwide network of service offices and mill depots has been established by the company. Information is available. ..**Item 130**

CEILING AIR CONDITIONERS. Page 48. Ceiling air conditioning units made by this company heat and ventilate a new 13,500-seat coliseum in North Carolina. The units have a combined capacity of 336,800 cfm. Information is available. ----------**Item 131**

VENTING VALVES. Page 49. A complete line of venting valves is offered by this company for every steam and hot water system. The line includes main vents, Universal air vents, and floats and traps. A condensed catalog is offered. ..**Item 132**

PIPE-RACKING CHANNELS. Page 50. A line of channels, clamps, hangers, concrete inserts, and rollers is made by this company for the support of steam, gas, heavy water, light conduit or air conditioning lines. The channels require no drilling, welding or riveting, and the framing is completely adjustable. A 78-page catalog is available. ---------**Item 133**

AIR-COOLED CONDENSER. Page 51. Remote-type, air-cooled condensers are now made by this company for big tonnage air conditioning systems. One is mounted on a supermarket roof and is used with a 100-ton system. Bulletin is available. ----------**Item 134**

CONTROL SYSTEMS. Pages 52-53. The heating, ventilating, and air conditioning of New York's new Coliseum are controlled by this company's control systems. In the offices, individual space control is obtained with heating-cooling thermostats regulating unit air conditioner valves. Information is available....**Item 135**

CABINET UNITS. Page 54. Cabinet units are made by this company for steam or hot water heating and chilled water cooling. They can be installed upright or inverted, fully exposed, recessed or concealed on walls, floors or ceilings and can be used with or without ducts. Bulletin is available. ----------**Item 136**

DATA BOOK. Page 55. A 52-page data book is offered by this company with photos, engineering and design features, specifications, and physical data on central station air conditioning units. The book includes coil data, psychrometric chart, selection data, temperature charts and tables, and fan information....**Item 137**

VALVES AND TAPS. Page 56. In a 41-building, Newark housing project thousands of this company's radiator valves and traps are used throughout the four big central heating systems. The company offers float and thermostatic traps for every heating service. Information is available. ----------**Item 138**

AIR-COOLED CONDENSERS. Page 57. Air-cooled condensers are available from this company in capacities up to 20 tons. The units have steel cases and are available arranged with either blower or propeller fans. Engineering and application assistance is offered. ----------**Item 139**

Postage Will be paid by Addressee

No Postage Stamp Necessary If Mailed in the U. S.

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 53, SEC. 34.9, P. L. & R., NEW YORK, N. Y.

AIR CONDITIONING, HEATING AND VENTILATING

93 WORTH STREET

NEW YORK 13, N. Y.

AD-DIGEST SERVICE

Ad-Digest

TEMPERATURE CONTROL SYSTEMS. Page 58. Electronic temperature control systems are made by this company for a zone or a building. Temperature settings are made at a remote center. Sensing elements are available with adjustment levers for individual room control. Information is available. ----------**Item 140**

HOT PIPE INSULATION. Page 59. This company's triple-zone hot underground pipe insulation was selected to protect 1200 ft of fuel and steam lines of a new steam electric station. The insulation is made in three types for varying temperature ranges up to 520 deg F. Information is available. ----------**Item 141**

AXIAL FANS. Page 60. An axial fan made by this manufacturer is an integral part of the duct in which it is installed. One can choose from a standard line of over 136 models, specially designed to meet the needs of modern industry. Bulletin is available. ----------**Item 142**

GALVANIZED SHEETS. Page 61. Anything that can be made of steel sheets can be made of the galvanized sheets manufactured by this company because the zinc coating will not chip or crack. Tight crimps and locked seams can be made with the sheets without breaking the coating. Samples and information are available. ----------**Item 143**

BOILERS. Page 62. This company's boilers were selected by a Tokyo printing plant to automatically supply steam to operate automatic printing equipment. The boilers are rated on nominal capacity to assure reserve power. Information is available. ----------**Item 144**

HIGH VOLUME HEATERS. Page 63. A line of high volume heating and ventilating units is offered by this company in 17 sizes ranging from 1280 to 32,500 cfm and in eight capacity ranges in both standard and jet tube steam coils. Eight fan discharge arrangements are offered. Catalog is available. ----------**Item 145**

COPPER WATER TUBE. Page 117. Copper water tube for refrigeration and air conditioning lines can be worked in tight corners because the solder or brazed joints need no wrench room and rust cannot clog the lines. A technical advisory service is available for assistance with problems. ----------**Item 146**

WASTE PIPE. Page 119. Acid proof pipe is made by this company for handling corrosive wastes. It is installed by minor plumbing methods and is stocked by leading jobbers. Catalog is available..**Item 147**

BOILERS. Page 121. Integral-furnace boilers are available in standard sizes to 40,000 lb steam per hr at pressures to 235 psi. The boilers have automatic operation, fuel-air ratio control, and smoke control. Two of them have been in service for the past two years supplying all the needs of a railroad station. Information is available. ----------**Item 148**

AIR DIFFUSERS. Page 125. Air diffusers with diffusing vanes provide air patterns unlimited without blank-off. The diffusers are made with square and rectangular outlet design. The company's engineering staff and laboratory resources are available. ----------**Item 149**

Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

DIRECT FIRED HEATERS. Page 125. Direct fired heaters are offered by this company where make-up air and tempering is a problem. The heaters come in six models and 66 sizes from 200,000 to 2,000,000 Btu per hr capacities. Complete information and specifications are available. ----------**Item 150**

UNIT HEATERS. Page 127. Three of this company's new 4-way unit heaters cover over 80% of a 100-ft wide building. The heaters are made for use with steam or hot water in 8 sizes from 55,000 to 60,000 Btu per hr. Information is available. ----------**Item 151**

HOT WATER GENERATOR. Page 129. The hot water generator made by this company is lined with baked-on plastic which is heat resistant to 500 deg F and leaves a smooth, non-porous surface that is easy to clean. Hot water generators, heat exchangers, air receivers and storage vessels are offered by the company. A 34-page reference catalog is available. ---**Item 152**

COPPER TUBE. Page 131 Copper tube is offered by this company for radiant heating because it unrolls easily into position on ceiling or floor, comes in 60- and 100-ft lengths, and can be connected with simple soldering techniques. The tube is color-coded for identification of type and size. Information is available. ----------**Item 153**

VALVES AND FITTINGS. Page 133. Four of the Navy's newest aircraft carriers are equipped with this company's cast steel and bronze valves, pipe fittings, flanges, and unions. The company is proud of its contributions to these vessels. Information is available. ----------**Item 154**

AIR FILTERS. Page 135. Air filters made by this manufacturer help control the atmosphere and lower air conditioning cost at a world famous research institute. The filters are used for three months in the air conditioning system to prevent dust build-up in electrostatic precipitators. Information is available.----**Item 155**

COOLING TOWERS AND CONDENSERS. Page 137 Cooling towers, in 2 to 120-ton capacities, and water-cooled condensers, in 1/3 to 25-ton capacities, are matched to work with each other. The wetted deck surfaces of the towers carry a 20-year guarantee against rotting or fungus attack. The condenser's tubes can be cleaned by a mechanical cleaning tube. Detailed specifications are available. -------**Item 156**

STEAM GENERATORS. Page 139. Steam generators for oil or gas, or both, are offered by this manufacturer in 18 sizes from 20 to 600 bhp for pressures up to 250 psi, or for hot water heating. The unit's 4-pass design provides 5 sq ft of heating surface per bhp. Catalog is available. ----------**Item 157**

ADJUSTABLE AIR DIFFUSERS. Page 141. Both round and square, adjustable air diffusers are offered by this company in addition to a new slot type. The diffusers blend unobtrusively with the architectural scheme of things. Specifications, engineering and installation information are available. ----------**Item 158**

INDUSTRIAL MOTORS. Page 143. The cooling surface of this company's ribbed motors prevents insulation failures under normal conditions. The engineered partner of these TEFC motors is the company's control system. Information on particular applications of the motors is offered. ----------**Item 159**

REFRIGERATING MACHINES. Page 145. Single-stage hermetic centrifugal refrigerating machines are made by this company to automatically adjust the refrigerating capacity to cooling needs. Variable inlet guide vents regulate the quantity, velocity, and direction of the refrigerant gas flow. Information is available. ----------**Item 160**

AUTOMATIC FIRING EQUIPMENT. Page 147. Every essential component is built into this manufacturer's forced draft firing systems, including burner, control panel, forced draft air supply, and fuel system. The firing unit can be applied to any type of boiler and fire gas, oil, or a combination. High or low pressure gas or oil from No. 2 to 6 may be used. Specifications are available. ----------**Item 161**

INQUIRY CARD

Circle below item numbers on which you wish catalogs or further information.

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PLEASE PRINT Aug. H-56

This service available only to U. S. and Canadian readers.

Name .....**Title** .....

Firm .....

Nature of Firm's Business.....

Street .....

City .....**Zone**.....**State** .....

This card is void after Nov. 1, 1956

Ad-Digest

AIR CONDITIONING EQUIPMENT. Page 150. One of seven complete lines of year-round air conditioning equipment offered by this manufacturer includes recessed room units and recessed console models. Literature is available. ----------**Item 162**

LINE OF FILTERS. Page 151. This line of filters for ventilating applications includes automatic air filters, viscous panel filters, dry panel filters, electric precipitators and electric mist collectors. Bulletins describing each of the filters are available. ----------**Item 163**

PACKAGED AUTOMATIC BOILERS. Page 152. Packaged automatic boilers are available from this company's stock for heating and hot water service up to 25 hp. They are offered for oil and gas firing and can be supplied with coils for storage or instantaneous hot water service. Bulletin is available. ----------**Item 164**

INSULATED PIPING SYSTEMS. Page 153. A recent installation of over 600 miles of pipe line was made with this company's products. A new catalog of prefabricated, insulated piping systems is available. ----------**Item 165**

PORTABLE CONTACT PYROMETER. Page 154. A portable contact pyrometer is made by this company for taking surface temperatures. Eight standard Fahrenheit ranges are available up to 1200 deg and a selection of thermocouples and extension arms. Bulletin is available. -------**Item 166**

COUNTERFLOW HEATERS. Page 155. Ten of this company's counterflow heaters were found to be the answer to the heating requirements of a Southern plant which required a conventional system that could not only handle normal needs but also meet varying demands. The company's heaters met requirements despite the large window areas. Literature is available. ----------**Item 167**

AIR CONDITIONING METHOD. Page 156. The air conditioning method offered by this manufacturer provides any temperature and relative humidity required. Humidity control is a separate function from heating or cooling. Bulletins are available with application information. ----------**Item 168**

SCOTCH BOILERS. Page 157. Scotch boilers are offered by this company for packaged heating units. The area of the boiler directly exposed to the radiant heat of combustion is a greater percentage of the total heating surface. Ratings are moderate but extra loads can be handled with larger burners. Information is available. ----------**Item 169**

CONDENSATE PUMP. Page 157. Condensate pumps are made by this company with a cast iron receiver, in capacities from 500 to 10,000 sq ft EDR. Single and duplex units are available. Bulletin is offered. ----------**Item 170**

GAS UNIT HEATERS. Page 158. Suspended gas unit heaters are made by this company for all industrial and commercial heating requirements. Gas-fired duct furnaces are also made for heating and heating-cooling systems. Catalog is available. ----------**Item 171**

CONDENSATE WATER REMOVER. Page 159. An automatic unit will remove hot or cold condensate fluids from the receiver tank and pump it to an outside drain or back into the equipment. It has a centrifugal pump delivery of 4½ gpm. It measures 5⅛ in. wide, 10 in. long, and 11¾ in. high. Information is available. ---**Item 172**

FIN TYPE COILS. Page 159. Fin type coils are made by this company for air conditioning, refrigeration, and heating in copper or steel hot galvanized. Pipe coils are also made in complicated assemblies or production runs from any type of pipe or tubing. Details are available...**Item 173**

CENTRIFUGAL VENTILATOR. Page 159. An aluminum, belt-drive centrifugal ventilator is manufactured by this company in sizes from 1000 to 16,500 cfm. Direct drive models are also available from 7- to 30-in. sizes. Catalog is available...**Item 174**

LIQUID DEPTH GAGES. Page 160. Remote reading tank gages are available in four models from this company to suit almost every industrial installation. The gages can be installed on tanks above or below the ground and up to one-quarter of a mile away. They can be obtained in multiple units on a single panel and mounting plate. Bulletin is available. ----------**Item 175**

VIBRATION CONTROL. Page 161. Vibration and noise control units made by this company permit the installation of heavy boilers, compressors, and fans on roofs without transmitted vibration to floors below. A booklet on upper floor installations and a bulletin on vibration control specifications for air conditioning equipment are available. ----------**Item 176**

REFRIGERANT INDICATORS. Page 163. Refrigerant indicators are made by this company in sizes ¼ or ⅜ in. for small air conditioners or refrigerators and in sizes to 1⅝ in. for large size commercial installations. The indicators have a pyrex glass window and are guaranteed to 500 psi. Catalog is available. ----------**Item 177**

HEATERS. Page 163. Direct fired, warm air heaters are made by this company in a full range of sizes for gas, oil, or gas-oil firing. A gas-fired, infra radiant heater is also made by the company for commercial and industrial heating. Bulletins are available. ----------**Item 178**

AIR FILTERS. Page 163. The line of air filters offered by this manufacturer includes: a viscous type, permanent and cleanable, in 1- and 2-in. thicknesses for low velocity systems; one that operates at 300 to 500 fpm in 2- and 4-in. thicknesses; and a permanent, cleanable grease filter in 2-in. thickness for range canopies and kitchens. Bulletins are available...**Item 179**

DRAFT GAGES. Page 165. Draft gages are made by this company from a solid block of clear plastic. A variety of stationary and portable gages is offered, each with tubing and accessories. Bulletin is available. ----------**Item 180**

SPRAY NOZZLES. Page 165. Choose the spray nozzles that give proper performance, with exact spray pattern, impact, spray angle, and capacity. A 48-page guide to spray nozzle selection is available with complete performance data. ----------**Item 181**

AIR DIFFUSERS. Page 165. The line of air diffusers offered by this company includes diffusers for cooling, diffusers for cooling and heating, supply and return diffusers, rectangular, square, and half-round diffusers. Adjustable diffusers are available as well as 1, 2, 3, and 4-way diffusers. Catalog is available. ----------**Item 182**

ZONE AIR CONDITIONING. Inside back cover. A new hospital wing is completely zone controlled by seven of this company's air conditioning units. One unit serves the requirements of eight different zones. Information is available. ...**Item 183**

AIR CONDITIONING CONTROL. Back cover. Air conditioning control systems are offered by this company for new or existing building whether single- or multi-story. Operation of the system is completely automatic for both heating and cooling. Information is available...**Item 184**

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AD-DIGEST SERVICE

Exterior view of the Temple of the Church of Jesus Christ of Latter-Day Saints, Los Angeles, Calif.

Details of the air conditioning system installed in a large church of outstanding design in Los Angeles, Calif. A separate building houses the steam and refrigeration plant to serve the church.

Church Is Fully Air Conditioned

AN air conditioning system capable of adjusting its operation from full to very low load. is functioning in the recently completed Temple of the Church of Jesus Christ of Latter-Day Saints, Los Angeles, Calif.

The choice of system was finally made on the basis of a refrigeration plant which would automatically adjust its capacity to the load from 100% to less than 10%, if need be. This was deemed necessary because of the large variation of internal loads to which it was known the building would be subjected. Other considerations were the choice of a machine requiring minimum maintenance and operation at a low noise level.

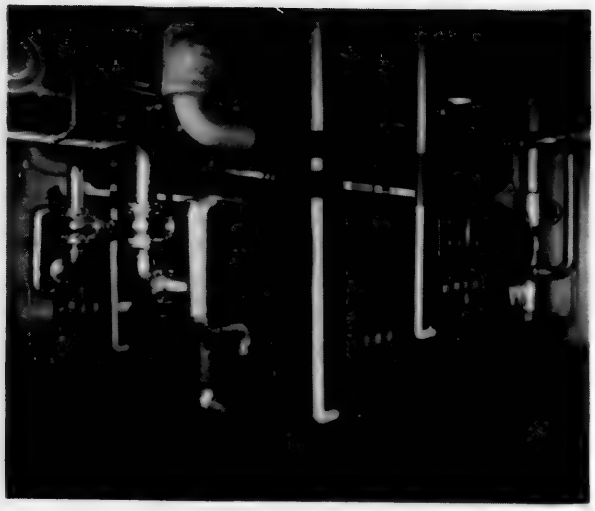
Separate building about 500 ft from the Temple contains the steam generating boilers and air conditioning equipment.

The steam and refrigeration plant is housed in a separate building located approximately 500 ft from the Temple building. The floor of this building is located some 15 feet below grade. At this same level a tunnel carries all the chilled and hot water pipes to the Temple building. Two steam powered, 137-ton Carrier absorption water chillers are installed.

Heating Load

The steam plant consists of two 174 hp Kewanee steel firebox boilers fired by Leahy multi-jet combination gas and oil burners. Normal firing, except on peak winter days, is by natural gas on an interruptible basis. Each boiler is capable of generating 6,000 lb of steam per hour at 12 psig. Besides furnishing the energy to operate the refrigeration plant, steam also provides domestic hot water requirements and hot water for the heating system. This is accomplished through two 1300 gal storage water heaters furnishing 180 deg water to serve the 200 people capacity cafeteria and other domestic requirements. Two Bell and Gossett convertors supply 120 to 190 deg water for the heating coils of the air conditioning units located throughout the building. Temperature variation is controlled by the heating demand.

Maximum steam rate for each of the two absorption machines is 19.6 lb per ton per hour. A total of 950 gpm water chilled to 45 deg is circulated through them. The chillers are operated in steps as required by the cooling load. Each chiller further automatically modulates its capacity to the load, according to demands of the system.



Cooling is provided by these absorption type units, supplied by a separate steam plant. A photograph of this boiler and equipment building appears on page 105.

The American Blower induced draft cooling tower circulating 1050 gpm is housed within a louvered extension of the steam plant building.

Air conditioning of the building is accomplished through twenty-three American Blower air conditioning units serving a total of thirty zones, circulating over 230,000 cfm conditioned air. Conventional low velocity duct systems are used throughout. Zone temperature control is achieved by three-way mixing valves on both the chilled water and hot water supply to the heating and cooling coils of each zone air conditioner. Reheat of some zones is employed for humidity control. Supply air distribution is for the most part by means of over 400 Anemostat ceiling air diffusers and high side wall diffusers mounted behind light soffits. Air is returned through registers located on low outside wall points wherever possible. Air to all but three zones is filtered, with Air-Maze electrostatic air filters.

This church was designed and construction supervised by Edward O. Anderson, architect, Salt Lake City. The mechanical design was prepared by Williams, Gritton & Wilde, consulting engineers, also of Salt Lake City.

Humidity Generator for Testing

A device for producing sudden changes in relative humidity at room temperature has been designed and constructed by the National Bureau of Standards.

The equipment was developed by S. Hasegawa, S. B. Garfinkel, and A. Wexler of the Bureau's Humidity Measurements Laboratory of the mechanical instruments secton as part of a program sponsored by the Navy Bureau of Aeronautics.

Growing out of the need for simpler and more convenient methods for testing meteorological hygrometer elements, the device is used to measure the speed with which such elements respond when the humidity changes suddenly from one fixed value to another.

A prompt response is important, for example, in hygrometers attached to balloons that rise swiftly through changing air strata; a lag in the hygrometer's response seriously reduces the accuracy of its continuously recorded measurements. Another application to which the humidity-change equipment can be adapted is the accelerated aging of hygrometer elements by rapid humidity cycling.

The apparatus consists basically of two closed and independent humidity systems, either of which may be connected to a test chamber. By means of solenoid-controlled valves, the chamber can be switched rapidly from one humidity system to the other. Air in each system is kept moving by an oil-free impeller-type pump, and for an air flow of 200 liters per minute the time required for the change from one humidity to the other is about 0.05 sec or less.

The value of the relative humidity in each system is controlled by a saturated salt solution. Held in a cylindrical glass chamber, the solution is made up as a slushy mixture with distilled water and chemically pure salt. It is well known that when a container is sealed and air is circulated within it to obtain equilibrium conditions, the space above the solution assumes a constant relative humidity. The precise value of this humidity depends on the salt used and also, in general, on the temperature. For the purposes of the present apparatus, however, it is possible to choose salts that produce the required relative humidity and which have a small or negligible temperature coefficient at room temperature.

In each humidity system, the air is driven by a pump first through a heat exchanger, which brings the air within the system to room temperature, and then conducted to the salt solution chamber where, by an arrangement of nozzles and baffles, it is brought in intimate contact with the solution. From the salt solution chamber, the air may take one or both of two paths. It may flow through a by-pass, and return directly to the pump, or, when the proper valves are open, it may pass through the test chamber before returning to the pump. When the valves are set so that the system is connected to the test chamber, another valve in the by-pass may be adjusted until a flowmeter indicates the desired flow rate through the test chamber.

During the time that one of the systems is connected to the test chamber, the air in the other continues to be circulated by its pump. Then, when the electrically controlled valves switch the chamber from one system to the other, the old air is quickly replaced by new.

To provide for different air speed requirements and for the different sizes of hygrometers tested, several interchangeable test chambers are used. In one of these air speeds up to 570 feet per minute have been attained. The flowmeter for measuring air speed is of the glass wool linear type.

So far the apparatus has been used principally for studies of an NBS-designed electric hygrometer element. In these studies, a check was made on the relative humidity in the test chamber by means of wet and dry bulb thermometers. It was found that the relative humidity is held constant within about 2 percent.

Economics of House-Heating Fuels

Some 45 papers were presented at a conference sponsored by the Institute of Fuel on Domestic Heating in Great Britain and devoted to present knowledge and trends in building heating fuels in England. The accompanying summary on the conference by our London correspondent emphasizes the great difference in present practice in England as compared to the United States.

IN May the Institute of Fuel organized a special Conference on Domestic Heating in Great Britain. The scope was by no means restricted to the heating of houses, large apartment buildings; district heating was included. Although members of the Institution of Heating and Ventilating Engineers were authors of some six or seven of the 45 papers presented, it was appropriate that the Institute of Fuel should be the organizers because many of the problems and argument over methods of heating derive basically from the fuel situation. The result has been a collection of authoritative papers summarizing present knowledge and foreseen trends as regards all fuels, heating methods, design of dwellings (including several papers by women, who have an especial interest here), and the establishment of smokeless zones. In addition to the texts, most of the papers have good lists of references which increase their value. The preprints have been bound in one handy volume and this will be followed by a second volume carrying late papers and reports of discussion, the set being obtainable from the Institute at 18 Devonshire St., London W.1., at a price of one guinea (3 dollars).

It should be noted that "all fuels" includes electricity but not natural gas. The U. S. Bureau of Mines has recently figured that the United States has been having a pleasant holiday with nearly two-thirds of its fuel needs being met by oil and natural gas, and that from now on there will be increasing dependence on coal and, in due time, Uranium. If this assessment is right, electricity for heating will become of increasing interest in America.

Reports, Insulation and Puzzles

The last really good stab at the building heating problem in Britain was made towards the end of the war and published as "Post-war Building Studies No. 19." It is always referred to, however, as the Egerton Report, since Sir Alfred Egerton, then Professor of Engineering at the Imperial College of Science and Technology, was Chairman of the committee which produced it. In an introductory paper to the present Conference, Sir Alfred reviews the conclusions in his report in the light of events during the past ten years. He begins by pointing out that Benjamin Franklin noted the defects of British heating methods, and proposed improvements, but that during the following century we failed to take his advice and are still suffering the consequences. The present pattern of fuel use for heating is something like 60% by use of raw coal, nearly 19% by electricity, less than 15% by city gas, 5% by coke, and less than 2% by oil, all these figures being in terms of coal equivalent.

Studies have shown clearly that the thermal efficiency of whole house heating is not necessarily the main factor in the total annual fuel bill. This is something which turns upside down the economies of insulation for buildings. Intermittent use of heat, controllability and less housework are all in favour of the increased and increasing use of electrical energy for heating; reduction of atmospheric pollution, and the proportion of coal which is unsuitable for purposes other than large-scale steam raising, work in the same direction.

Experiments by the Building Research Station to test in practice the value of insulation (which could be shown theoretically to be well worthwhile, in spite of the complications) produced some interesting results. Some tenants of the better-insulated houses used just as much fuel as those in houses with poor insulation; they took advantage of the insulation to obtain a higher standard of comfort.

Atmospheric pollution, smokeless solid fuels, increased use of imported oil, building insulation, the habits of tenants, these are but parts of a jumbo jigsaw puzzle which Sir Alfred hoped to be able to solve but in his conclusion he has to confess he has been unable to do so.

Fuels for Heating

Dr. G. E. Foxwell started the first conference session with a paper on the question of what fuels Britain's domestic heat would come from in the future. He concludes, and his opinion must be respected however much one may disagree with it, that the main winter space heating load will be taken by solid fuel at least during his lifetime. He is an older man than your Correspondent. If city smoke is to be reduced, then there has to be a much greater production of smokeless solid fuel. No city in Britain can behave like Pittsburgh and forbid the importation of particular fuels; its citizens would go cold as a result because the smokeless fuels are not available in sufficient quantity. Dr. Foxwell concedes that the price to be paid for coke suitable for burning in room-heating appliances may be higher than the present price. He does not realize that the price may be so high as to make it more expensive than, say, oil.

It is therefore interesting to turn to the next paper in which J. E. Davies, Chief Technical Officer of the Gas Board which supplies all London south of the Thames and the counties of Kent, Surrey, and Sussex, where there is perhaps a population equal in numbers to that of the State of Illinois but no coal suitable for gas manufacture. First he tells one of those unfortunately true fairy stories which devotees of Planned Economy would like to use as a nail in the coffin of Free Enterprise. After the war new designs of open fire were produced to burn coke. These were more efficient with coke than other fires with bituminous coal. Some were fitted with back-boilers for water heating. So that the water would be sure to be hot in the morning the fires were next designed to burn all night. A low grade of coal consisting of a few lumps in some black dust was found surplus, called "Nutty Slack," was allowed to be purchased for domestic use in addition to the rationed allowance, and was advertised as a means of keeping these smokeless fires burning overnight. This

of course produced as much smoke at night as a well run open fire produces during the day, but nobody could see it, and "wot the eye don't see the 'eart don't grieve." Since the fires would not now go out, it was unnecessary to go to the trouble and expense of fitting them with gas ignition. This made it practically impossible to burn coke in them anyway. So thousands of such "improved" fires are in use all over the country burning smoky bituminous coal with no better efficiency than the older fire-grates they have replaced.

Davies then goes on to compute the *value* and the *cost* of coke and of special smokeless fuels as a means of arriving at a *price* to be paid by the consumer. He simply shows that the value per ton is only some 12% greater than that of coal (supposing that the consumer is allowed by law to use raw coal). On the other hand, the cost of manufacture of coke is 1½ times to twice the cost of coal delivered at the carbonising plant. It is not surprising that responsible persons in the gas industry are beginning to think of the future in terms of cheap methods of total gasification of coal, elimination of expensive carbonising plant, and the eventual disappearance of coke as a domestic fuel. This may also be the future for the U. S. A. as the demand for gas overtakes the supply of natural gas. Research in both countries is devoted to the same ends.

Use of Electricity

A paper of considerable interest is that by J. W. Moule, Commercial Officer of the South of Scotland Electricity Board. This Board was split off a year ago from the British Electricity Authority by combining two Area Boards (distribution and sales) with two Generating Divisions. It is an interesting experiment in utility supply. The rest of England and Wales is supplied with electricity under an arrangement in which all power stations and high voltage

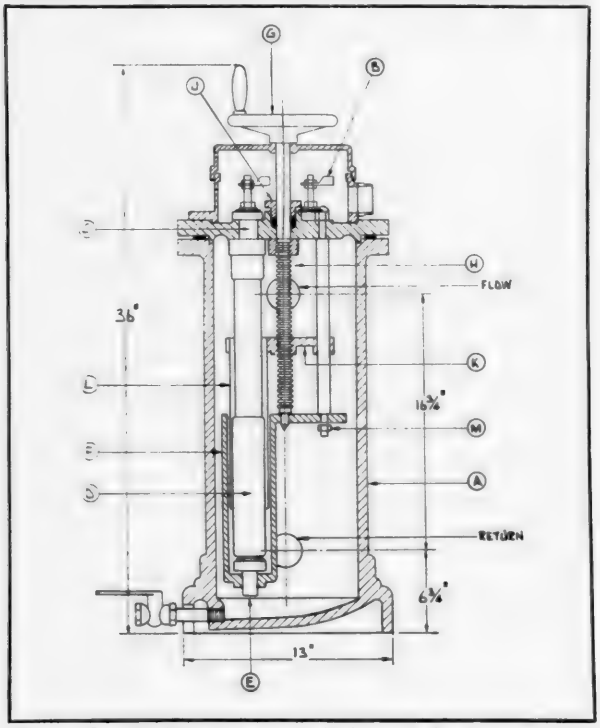


Fig. 1. Sectional arrangement of electrode hot water heater with hand-wheel control. D—electrodes; F—neutral shields; G—handwheel; L—insulating sleeves which separate electrodes from shields. (Institute of Fuel)

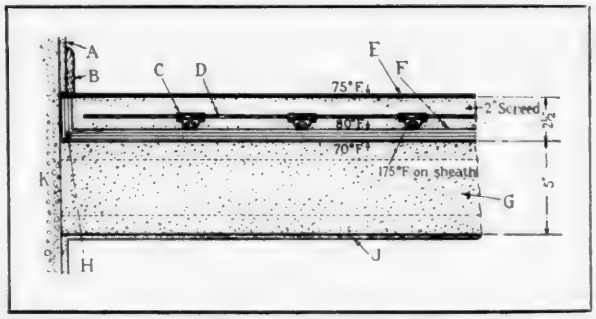


Fig. 2. Typical section through floor of apartment building at Kirkcaldy, Scotland, showing electric heating elements. A. Plaster finish. B. Skirting board. C. Cable housing, clamp and heating cable on 6 in. centers. D. Light-gage expanded-metal heat diffuser. E. ⅛ in. Marley tiles on bituminous solution. F. 1 in. paper-bound glass insulation compressed to ½ in. G. Hollow concrete bison floor slab. H. Insulation turned up to minimize sound transmission. J. Plaster ceiling. K. No-fines concrete main building structure. (Institute of Fuel)

transmission are built and operated by the Central Electricity Authority; this is leading to good technical liaison on difficult and highly specialized problems. But the supplies to the public are in the hands of separate Boards who buy electricity in bulk and retail it. They have little incentive to consider problems of generation in developing load. South Scotland (the North is entirely hydro and separate again) is beginning to view the situation as a whole: beginning to look at day and night, winter and summer loads not merely in terms of finance but in terms of which plant will be running and what the additional coal cost of extra night load would be if the waste in shutting down and starting up could be avoided. It is surprisingly low. Surprisingly only, however, to commercial officers and distribution engineers who have not worked in power stations. Even the assessment presented here gives no weight to the wear and tear involved in rapid variations on large generating sets.

It all adds up to the fact that it would pay to provide electricity at night for heating at a price that makes the heat competitive with other "fuels." An alternative that would help in keeping Britain's projected nuclear power stations to operate at a steady load is pumped storage: water is pumped up to a high level reservoir at night and allowed to flow down again through the turbines during peak demand hours. This is already being used in the U. S. A., for example by TVA. But the efficiency is only 70%, and the capital cost is comparable with that of building power stations, even on the very few most suitable sites. If this electricity could be sold directly at perhaps 60% of guaranteed daytime supplies, it would be better to sell it.

Therefore there is much interest in off-peak use of electricity for space heating. Figure 1 shows a three-phase electrode central heating boiler. The handwheel *G* raises or lowers the insulating sleeves *L* which separate the electrodes *D* from the neutral shields *F* which surround them, thus controlling the heat output. There are now several hundred installations of this type with outputs up to 20 kw or 70,000 Btu per hr. Storage in the system is adequate to tide over the periods of 8 to 10 a.m. and 3 to 5 p.m., during which the supply is cut off under the off-peak tariff.

Figure 2 shows a floor warming installation in an apartment building at Kirkcaldy. This building has 24 2-room

(*Concluded on page* 152)

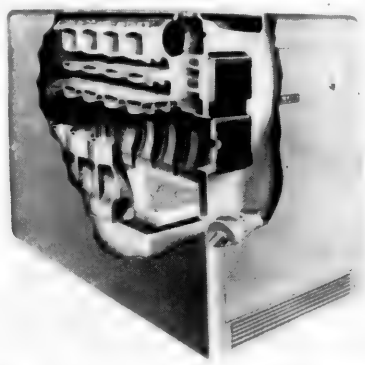
NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on page 101 for securing additional information on new equipment and materials described in this department.

Oil-Fired Boiler

An oil-fired boiler, No. 72, is available from Weil-McLain Co., Michigan City, Ind., for hot water and steam, with net IBR ratings of from 161,000 to 331,000 Btu per hr.

Self-regulating, reversing flue gas travel is a feature of the boiler. It involves breaking the hot gases leaving



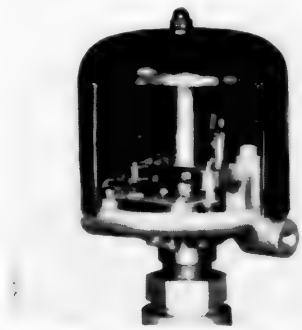
the combustion chamber into small streams, each of which contacts the cooler sides of the firebox.

The burner furnished with the unit features an aluminum alloy housing. Nozzle adjustment may be made to forward, backward, or lateral positions while the burner is operating. Asbestos rope inserted in a grooved putty strip allows expansion and contraction and will last the life of the boiler.

More information? Circle Item 1 on postcard, page 101.

Pneumatic Pilot Mechanism

The Magnetrol J-1 pilot mechanism is announced by Magnetrol, Inc., Chicago, Ill., for liquid level control where pneumatic operation is preferred. It is available in all styles including external float cage, top-mounting, side-mounting and displacement type as well as flow switches;



and for a wide range of pressure and temperature requirements. In its on-off action, magnetic force is used to link float movement with switch action. Required adjustments are made with an Allen wrench supplied with the control. Working parts are fabricated from stainless steel, as the mechanism is designed for use with well-head gas as well as regular instrument air. Flapper pressure against the nozzle will seal off air flow against 0-30 psi in standard models and up to 100 psi in models furnished with a special flapper coating.

More information? Circle Item 2 on postcard, page 101.

Seamless Flexible Hose

A seamless, brass, flexible hose is made by Techniflex Division, Port Jervis, N. Y.

Named Flexco, the tube is designed for both domestic and industrial uses where working pressures are 120 psi or less. It can convey steam, oil, water, air, or any other liquids and gases that are non-corrosive to copper alloys with a 120-psi working strength and a 2000-psi burst strength.

The hose is available in $\frac{3}{8}$- or $\frac{1}{2}$-in. sizes with fitting combinations in lengths from inches to 5 ft.

More information? Circle Item 3 on postcard, page 101.

Cooling Condensate Pumps

Two models, A and B, of condensate removable pumps have been placed in production by March Mfg. Co., Inc., Skokie, Ill.

Model A (illustrated) is adaptable to low tonnage air conditioning units, unit coolers, flash coolers, ice machines, and other units with limited space. It has a maximum vertical lift of 6 ft; a horizontal run of 200 ft; and

capacities ranging from 45 gph at zero vertical lift to 5 gph at its maximum vertical lift. The dimensions of the unit are $3\frac{1}{8}$ in. wide, $3\frac{1}{2}$ in. high, and $4\frac{3}{8}$ in. long.

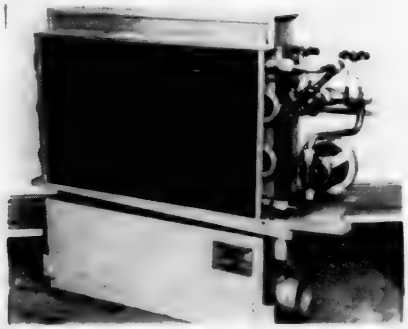
Model B has the same overall dimensions, but has a 9-ft maximum vertical lift and a 300-ft horizontal run with capacities ranging from 65 gph at zero lift to 10 gph at maximum lift. All four legs of this model are adjustable so that it can be used in irregular or angular floor drip pans.

Both models have air bleed systems to prevent air lock; $\frac{1}{8}$ in. pipe outlets for rubber hose connectors; and $\frac{1}{4}$-in. copper tubing flare fittings for direct attachment to $\frac{1}{8}$-in. pipe.

More information? Circle Item 4 on postcard, page 101.

Three Valve Manifold

A three valve manifold cluster has been designed by Worthington Corp., Harrison, N. J., for use with its induction circulators. to eliminate intricate layouts of the piping connections to the unit, normally prepared by the piping contractor. The cluster also provides a means of getting the proper fit of all piping parts involved in the water feed to the units.



The valve cluster may be adapted to left or right hand connections of the coil by rotating the two main connections 180 degrees. The clusters combine inlet and outlet stop valves and the bypass valve in one casting for installation on the induction circulators used in high pressure induction systems.

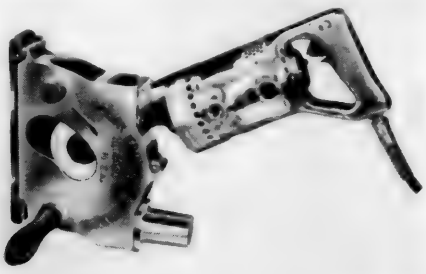
This combination enables the piping contractor to purchase a complete valve and piping assembly, ready to assemble to the coil ends. The assembly has flare nuts to mate with coil ends. The three valve manifold connections are available with flare or sweat ends.

The clusters are also available for use with pneumatic control valves (as illustrated), manual control valves. and self-operating type automatic control valves.

More information? Circle Item 5 on postcard, page 101.

Tool Grooves Plaster

An electric plaster grooving machine has been designed by Wodack Electric Tool Corp., Chicago, Ill., to permit the laying of electrical conduit and metal tubing without filling the air with plaster dust or messing floors. Known as the Plaster Groover. the tool is powered by a universal motor operating on a-c or d-c current. It uses



a 6 x 1¼ x ½-in. abrasive wheel with a guard and a support handle. The guard is equipped with a nozzle for attaching the hose of any commercial vacuum cleaner. The nozzle opening is closed when the cleaner is not used.

The handle has a trigger switch and 15 ft of Neoprene cord with a plug. The entire unit is 18 in. in length and weighs 16 lb.

When attached the vacuum cleaner solves the plaster dust problem when installations are being made in hospitals, homes, or offices. The 6-in. abrasive cutting wheel makes a single cut, up to 1¾ in. in depth, through plaster, lath. brick. or concrete.

The tool is suitable for installing temperature control systems and central oxygen systems in hospitals.

More information? Circle Item 6 on postcard, page 101.

Room Cooler Adapter

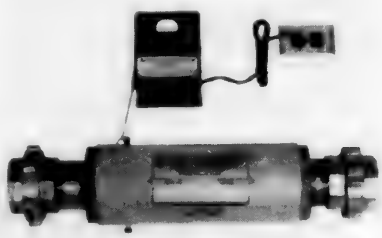
An adapter that permits a room air conditioner to be mounted on the roof is distributed by Cool-Aire. Los Angeles, Calif.

The adapter is designed for use with the Duo-Therm air conditioner made by Motor Wheel Corp., Lansing, Mich. It enables the air conditioner to be installed on a vent or over a 14-in. hole in the roof.

More information? Circle Item 7 on postcard, page 101.

Water Scale Control

An electric scale control unit is offered by Aqua Electric Scale Control, Inc., Cleveland. Ohio. to prevent scale-forming elements in water. such as calcium and magnesium carbonates and sulfates. from building up on the walls and tubes of equipment. Instead, it allows them to be precipitated in a soft sludge. most or all of which is ordinarily removed from the system by blow-down, periodic draining. or simply the flow of the water itself.



Once the formation of successive layers of new scale has been stopped through the use of the unit, a secondary effect generally results in a gradual disintegration and breaking loose of old scale. However, this is an added benefit and not the primary function of the unit.

Mechanically, the unit consists of two parts: (1) a cylinder constructed of plastic, which contains the treating electrodes; and (2) the control box, which supplies current to the treating electrodes and regulates the amount of current supplied according to the requirement of the particular water being treated.

The unit comes complete with inlet and outlet nipples and unions as shown and can ordinarily be installed in about one hour. The control box is furnished with cord and plug, which is inserted into a convenient base or wall receptacle.

More information? Circle Item 8 on postcard, page 101.

Sheet Metal Brakes

A series of brakes for bending and shaping sheet metal are being manufactured by Barth Engineering & Mfg. Co., Milldale, Conn.

Available in 4, 6, 8, and 10-ft sizes, the plain brakes are for general use in sheet metal shops doing warm air duct work, tanks, skylights, signs, store fronts, cornices, and roofing jobs.

Universal brakes are also made by the company with the same action and scope as the plain brakes. However, with various combinations of fingers in place, the length of the bending edge is varied to accommodate different sizes of boxes, pans, trays, and cabinets. They are made in 4, 6, and 8-ft sizes. The finger extension is 6 in. and the standard finger widths are 3, 4, and 5 in.

A third brake, the combination, consists of lighter gage machines adaptable to either of the above types of work and are especially suitable for duct and fitting work. These brakes are made in 3- and 4-ft sizes. The finger extension is 4 in., with a capacity rated for 1-in. flange on mild steel.

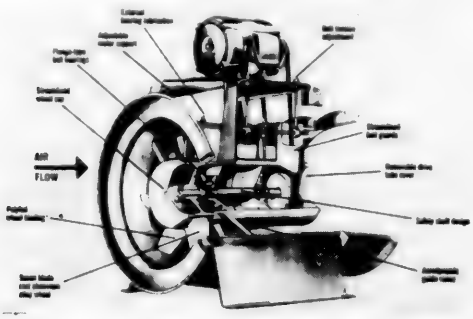
The bench brake is designed for small job shops and home workshops. They are also made in 3- and 4-ft sizes, with capacity rating for a $\frac{3}{8}$-in. flange on mild steel.

More information? Circle Item 9 on postcard, page 101.

Axial Flow Fans

Airfoil-type blading has been extended to the Axiflo fan line by the Sturtevant Div. of Westinghouse Electric Corp., Boston, Mass.

Designated as Series 300, the design provides improved air exhaust performance or process air supply in chemical,



ceramic, textile, foundry, paper and industrial finishing applications.

A non-overloading horsepower characteristic allows increased air handling capacity and eliminates need for oversize motors in the normal operating range.

The fans are available in three drive arrangements: External V-belt drive, direct drive with motor inside the casing and direct drive with motor outside inlet opening. There are 14 sizes of fans with volumes ranging from 1700 to 100,000 cfm, wheel diameters from 15 to 72 in. and static pressures up to $3\frac{1}{4}$ in.

More information? Circle Item 10 on postcard, page 101.

Fuel Oil Valves

A vertical ball check valve and a foot valve are made by Remco Inc., Baltimore, Md., for fuel oil lines from tanks lower than the burner to prevent the oil from draining back to the tank and causing the pump to lose its prime.

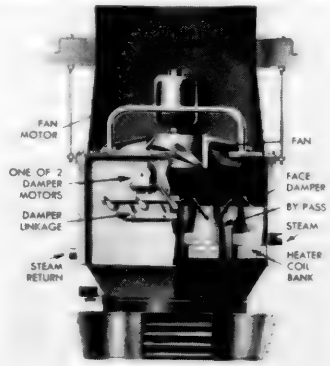
If the valve is to be installed at the burner the vertical ball check valve should be used. If, however, the valve is to be placed at the end of the suction line, the foot valve should be used and installed a few inches off the bottom of the tank.

A feature of both valves is that the flare type copper tube fitting is built into them and is an integral part of the valves. Both $\frac{3}{8}$- and $\frac{1}{2}$-in. flares are available. The vertical ball check valve is made with a $\frac{1}{4}$-in. MPT.

More information? Circle Item 11 on postcard, page 101.

Fresh Air Supply Heaters

A heater for supplying fresh, warmed air to a building or room to replace air exhausted in manufacturing processes, is announced by L. J. Wing Mfg. Co., Linden, N. J. Known as the FAS Unit Heater, it consists of a motor and fan, a heater section comprising alternate heating and by-pass passages and a distributing outlet. Air brought in



through the heating passages passes over extended surface steam coils. Air brought in through the by-passes is not heated.

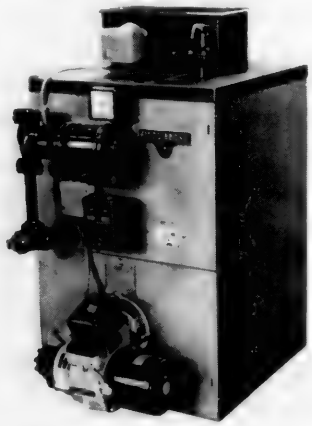
Volume control dampers on all passages, operated by synchronized damper motors, are actuated by an air stream thermostat or room thermostat. Dampers on the heating passages and the by-passes operate according to temperature requirements. The blended discharge air stream is maintained at a pre-determined temperature and constant volume.

The steam pressure in the coils is the same as in the supply main at all times.

More information? Circle Item 12 on postcard, page 101.

Boiler-Burner Units

A lower priced line of the 770 Series boiler-burner units featuring increased tankless domestic hot water and a wider range of sizes, is announced by Fitzgibbons Boiler Co., Inc., New York, N. Y. The redesigned 770 is available



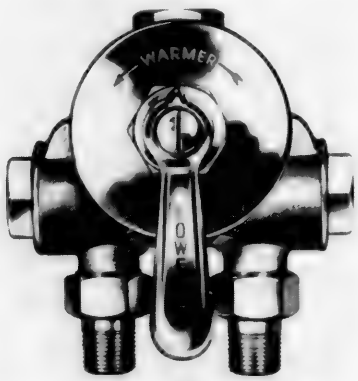
in four sizes from 74,000 to 149,000 Btu per hr for hot water heating system. Redesign of the firebox area and incorporation of a special, quick glowing combustion chamber has been made to provide cleaner, quieter operation. The Fitzgibbons Tanksaver and its control system have been revised to furnish up to 5 gal of hot water per min in the largest size unit. A new control system assures domestic hot water at all times.

More information? Circle Item 13 on postcard, page 101.

Water and Steam Mixing Valve

Cold water and steam can be automatically mixed to provide hot water at any desired temperature by a mixing control made by The Powers Regulator Co., Skokie, Ill.

Called the Style D Mixer, the control can be used to obtain hot water where only cold water and steam are available, or to superheat plant hot water for a processing application.



Typical hot water applications for the control are in the dairy, meat packing, chemical processing, rubber vulcanizing, papermaking, canning, confectionery, and oil processing fields.

The mixer takes steam and cold water at pressures from 10 to 100 psi. Turning the handle regulates the temperature of the discharged hot water at any point from that of the incoming water to 200 deg F, regardless of pressure changes in supply lines.

A pressure equalizing valve, consisting of a floating piston, controls and equalizes the pressure of steam and water before they enter the mixing chamber. The valve compensates for pressure variations in supply lines caused by other outlets on the lines.

Check valves built into each inlet prevent the interchange of steam and cold water when the mixer is not in use. The temperature adjustment handle also operates an internal delivery, shutoff valve.

The mixer is available in ½- and ¾-in. sizes. Additional information is contained in Bulletin 309.

More information? Circle Item 14 on postcard, page 101.

Flange Fits 3 Bowls

A closet flange that will fit 10, 12, and 14-in. closet bowls has been designed by American Specialty Co., Chicago, Ill.

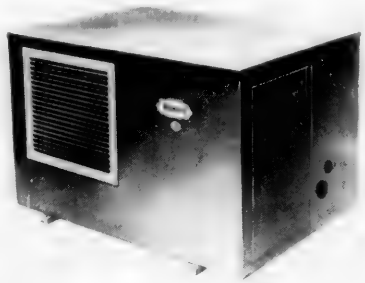
Measuring 5 in. ID and 2 in. high, the flange can be used on old as well as new installations. It is adjusted to the bowl size by turning right or left and is designed to prevent breaking the bowl.

More information? Circle Item 15 on postcard, page 101.

Outdoor Condensing Unit

Addition of a semi-hermetic outdoor condensing unit to the company's line of high-torque semi-hermetic motor compressors and condensing units is announced by the Brunner Company, Gainesville, Ga.

The totally air-cooled units, available in either 2 hp or 3 hp, and known as Models RAC-2 and RAC-3, are designed for operation in ambient temperatures to 120 deg F.



The units are engineered for use in air conditioning and commercial refrigeration in residential locations where water is scarce or prohibitive in cost, in buildings lacking basement space and in farm application for bulk milk cooling where inside space is at a premium.

Enclosed in a weatherproof steel cabinet, the unit measures 40 inches in length, 32 inches in depth and 25¼ inches in height and may be placed adjacent to a building at ground level or installed in roof construction.

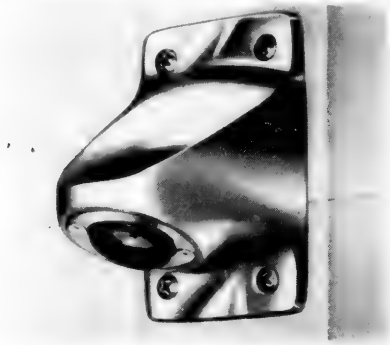
Condenser air per ton is 1000 cfm. A combination heating-cooling thermostat is available as an accessory. A control panel opens to expose all electrical components for inspection.

More information? Circle Item 16 on postcard, page 101.

Institutional Shower Head

An institutional shower head for schools, hospitals, and prisons is introduced by Plumbing and Heating Div., American Radiator & Standard Sanitary Corp., New York, N. Y.

The body of the shower head harmonizes with the company's line of Quality brass fittings and is finished in



polished Chromard. The face plate may be adjusted to give spray angles of 15 or 30 degrees from the wall. The smaller angle of water delivery is important where the shower area is partitioned into separate stalls.

The head can be made vandal-proof where the need arises. For blind installation to eliminate exposed screw heads, four holes are tapped in bosses provided in the body casing for this purpose; the regular mounting holes are left undrilled.

Made of black mineral-filled phenolic resin, the face plate is unaffected by sustained temperatures up to 180 deg F, and resists temperatures up to 220 deg for limited periods. Serrations force the water stream into a compact shower pattern; the volume and velocity of water can be adjusted and locked with an Allen head screw.

The cast brass body is available with tappings for either ¾- or ½-in. IPS supply. It is furnished regularly with ½-in. tappings. On special order, the body casting can be provided with a bottom tapping for exposed supply lines.

More information? Circle Item 17 on postcard, page 101.

Sheet Metal Notcher

A machine designed for punching various shapes along the edge of a sheet of metal is announced by Consolidated Marketing Corp., Philadelphia, Pa.

Called the Ruoff Notcher, the machine permits variable spacing, depth, and patterns. It is essentially a punch press with an adjustable automatic feed that permits production without the long press runs required for the practical operation of large presses. It handles both flat and circular stock and is suitable for notching the dovetail or clinch collars used in heating, ventilating, and air conditioning systems.

Mounted on a stand so that the cutting level is 3 ft from floor, the unit is operated by ¼-hp motor. The automatic feed puts material through at speeds up to 13 fpm. The notcher accommodates sheet steel in thicknesses up to the equivalent of 21 gage (0.329 in.). Thicker materials can be notched in proportion to their shear strengths.

One adjustment decreases or increases the notch spacing up to ⅞-in. centers; another reduces the notch depth from a maximum of ¾ in. The notcher comes equipped with standard male and female dies which make a 15-deg notch, however, special dies for other patterns are obtainable.

The notcher is 18 in. wide, 12 in. deep, and 50 in. high. Its crated shipping weight is 70 lb.

More information? Circle Item 18 on postcard, page 101.

Large Water Heater

A gas-fired water heater for large users of hot water is offered by Bock Corp., Madison, Wis., in two sizes: Model 132G, 100 gal. and Model 136G, 135 gal.

Fully automatic with one or more thermostats to control the water temperature, the heater is suitable for general purpose or sanitizing water for schools, dormitories, apartments, motels, restaurants, launderettes, and public buildings. It may be used as an instantaneous heater or as a circulating heater with an additional storage tank. The storage tank may be of a capacity up to three times the hourly recovery of the heater. In some cases two or more heaters connected either in tandem or series will give the best results.

The boiler is of the water leg type enclosing the combustion chamber with water to the floor. It may be mounted on wooden floor. Clean-out plugs give access to the water. All tubes are ¼ in. thick.

More information? Circle Item 19 on postcard, page 101.

Multiple Drinking Fountains

Multiple, wall-mounted drinking fountains (Model 10Y) are introduced by Haws Drinking Faucet Co., Berkeley, Calif.

Made of reinforced Fiberglas, the fountains are available in choice of five decorator colors, in addition to white.

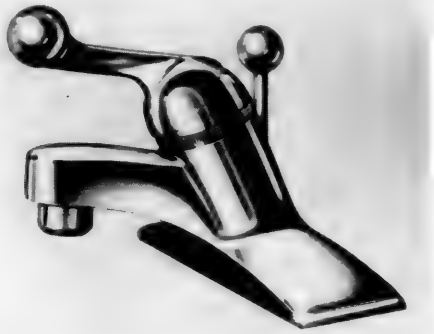
The three angle stream fountain heads are raised and shielded to prevent direct mouth contact. The valves have automatic stream control and are self-closing. All exposed fixtures are made of polished chrome plated brass.

The fountain is designed for use in locations where multiple drinking facilities are required to accommodate crowds of people.

More information? Circle Item 20 on postcard, page 101.

One-Handle Lavatory Faucets

A line of single-handle lavatory faucets is announced by Delta Faucet Div., Masco Screw Products Co., Dearborn, Mich.



The faucets have only one movng part—a hardened, ground ball operating in a socket joint. The one moving part controls both the temperature and volume of water with one movement of the hand.

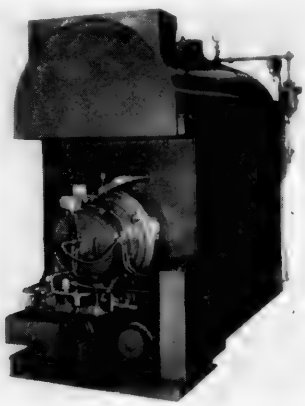
Available in four models, the faucets have 3/8-in. tubing connections that are 4 in. long on 4-in. centers. Its base is 2 in. deep and 7 in. long.

More information? Circle Item 21 on postcard, page 101.

Packaged Fire-Tube Boilers

Fire-tube boiler-burner units with the installation and operating advantages of the Scotch marine type packaged steam generators are offered in the YFB line by York-Shipley, Inc., York, Pa. The package design eliminates the need for stack, pitting and brickwork. Water cooling virtually eliminates replacement and maintenance costs of the carborundum combustion chamber and increases boiler capacity.

A four-pass arrangement of the boiler tubes assures maximum heating efficiency. The unit can be furnished to supply either low-pressure steam (15 psi) or hot water (30 psi). Firing may be by No. 3, 5 or 6 oil and/or natural or manufactured gas. Boiler can also be converted to coal firing by the addition of a grate.



Double-shell construction allows combustion chamber to be surrounded by a water blanket 3½-in thick. The firing tube also includes a 4-gallon circular reservoir where fuel oil may be preheated. The water that has been preheated by flowing around the fire tube afterwards goes to boiler feed, improving heating efficiency and avoiding the thermal shock of introducing cold water to the boiler. The oil-preheating reservoir is said to do away with the need for a below-the-water-line heater.

Firing head is an air-atomizing burner assembly. Chassis assembly and windbox are also the same.

The factory-assembled unit has a solid ¼-in. plate welded between the boiler and the base. This steel plate is covered by a 2 to 2½-in thickness of castable insulating refractory, which goes over the entire bottom of the firing area. Air for the burner is drawn through the base section, cooling the base so the boiler can be installed on a normal concrete floor.

The new line of fire-tube boiler-burner assemblies is offered in equivalent net steam ratings of 3,000 to 35,000 sq ft and in equivalent net hot water ratings of 4,800 to 56,000 sq ft. Each boiler-burner unit is fire tested and adjusted for high and low fire prior to shipment from the factory.

More information? Circle Item 22 on postcard, page 101.

Corrosive Scale Treatment

A concentrated treatment for the prevention of corrosion and scale in air conditioning units is made by American Sand-Banum Co., Inc., Freeport, N. Y., in briquette form. The briquettes are a combination of tropical resins, organic vegetable substances, corrosion inhibitors, and emulsifying agents.

Being a collodial preparation, the briquettes' dispersions have a large capacity for surface adsorption and activity. The dispersions of minute particles suspended in the water attract and hold foreign matter, causing a spongy disintegration of scale. The impurities are adsorbed until they become entirely attached to the colloidal particles. A film of the treatment's particles are also attracted to metal surfaces protecting them from corrosion.

The briquettes may be placed in a screen basket in the sump of the unit or in a feeder placed on the make-up or circulating line.

More information? Circle Item 23 on postcard, page 101.

Women's Urinal

A woman's urinal, the Femigene, is announced by Richmond Plumbing Fixtures Div., Rheem Mfg. Co., Metuchen, N. J.

Made of vitreous china, the urinal is available with a pedestal type floor outlet (Model G-380) or with a wall outlet (Model G-385). The unit has an integral flushing rim and a syphon jet with a 1½-in. top spud. Round china bolt caps are furnished with it.

The urinal is available in seven colors and white. The seven colors are: azure blue, Bermuda coral, fern green, oriental ivory, Quaker gray, tropic tan and mellow red.

More information? Circle Item 24 on postcard, page 101.

Electric Hot Water Generator

An electric hot water generator is a new product of Precision Parts Corp., Nashville, Tenn.

Five major uses of the hot water generator include heating homes, churches, hospitals, motels, and commercial buildings; melting snow and ice on sidewalks and

driveways; controlling temperatures of swimming pools; supplying hot water for homes, apartments, hotels, hospitals, and for industrial purposes; and as an auxiliary heating system where one or more rooms are being added.

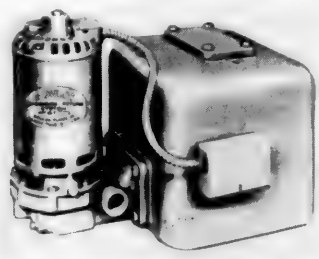
The factory-assembled unit includes generating tubes, thermostats, a water circulator, and a safety valve. It is designed for radiant panel, convector, baseboard, and radiator-type heating systems.

More information? Circle Item 25 on postcard, page 101.

Condensate Return Pumps

A new series of condensate return pumping units for both closed low pressure steam heating systems or process equipment, and for boiler feed condensate return has been introduced by Goulds Pumps, Inc., Seneca Falls, N. Y. Single and duplex units may be obtained for straight condensate return and also for boiler feed condensate return systems.

The straight condensate return units for low pressure steam heating systems and process equipment are automatically operated and consist of a receiver tank to which



is connected a close-coupled centrifugal pump. The pump is electrically controlled by a float switch in the receiver tank. Pumps are bronze fitted single stage type. Impellers are one piece statically balanced. Ceramic seat mechanical seals permit operation for water up to 212 deg F.

The boiler feed condensate return system automatically blends raw make-up water with hot return condensate. A valve introduces make-up water to receiver at intervals as determined by boiler load demand. Heat is absorbed evenly with resultant minimum degree of fluctuation in fire.

Duplex units have two pumps which, in straight condensate return systems, alternate in operation. On boiler feed condensate return systems operation of pumps is governed by a two level boiler control, starting and stopping both pumps in sequence.

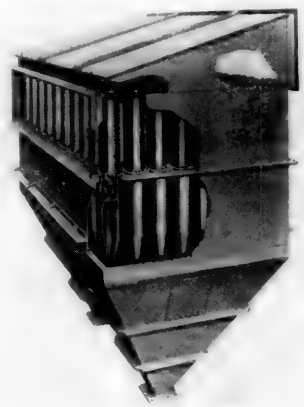
Receivers in both return systems vary in capacity with 7, 14, 40, 60 and 100-gallon units.

More information? Circle Item 26 on postcard, page 101.

Mechanical Dust Collector

A mechanical dust collector of the multiple tube type is announced by Research-Cottrell, Inc., Bound Brook, N. J.

Designated the Cyclo-trell, the collector consists of a series of cyclone tubes arranged in parallel and depends on centrifugal force for its operation. The incoming gas enters the chamber under pressure and flows into the lower set of inlet tubes, which are attached to the lower header plate and are of slightly larger diameter than the upper outlet tubes. Vanes at the mouth of the inlet tubes set up a circulator motion in the gas so that suspended



particles are forced downward and outward against the wall of the inlet tube. Cleaned gas is first forced toward the center of the collector tube and then upward and into the outlet tube by the pressure differential.

The purpose of the inlet vanes is to start a fast spiral of incoming gas with a minimum of turbulence. The faster the gases spin the greater the centrifugal force on the suspended dust in the gas stream. The collection efficiency increases as the centrifugal force is increased. The use of the aerodynamically shaped vanes minimizes gas turbulence and increases the centrifugal force.

The outlet vanes serve the function of recovering energy in the outlet tube, thus increasing the capacity of the tube. This results in fewer tubes per unit. The vanes are positioned below the tube to decrease entry losses at the tube.

The shell and hopper of the collector are made of 7-gage bolted steel, with cast iron inlet tubes and vanes to resist the abrasive force of the incoming gas.

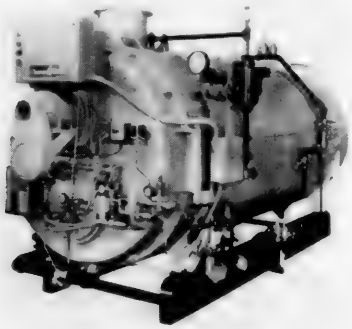
More information? Circle Item 27 on postcard, page 101.

Boiler Line Is Expanded

A 200-hp self-contained unit expands the CB line of boilers made by Cleaver-Brooks Co., Milwaukee, Wis., to include twelve sizes from 15 to 200 hp.

Equipped with modern combustion and safety devices, the boiler is offered in the following series: Series 100, light oil; Series 200, No. 2 oil and gas; Series 400, No. 6 oil and gas; Series 600, No. 6 oil; and Series 700, straight gas.

Built with design features similar to those of the 125- and 150-hp models, the 200-hp boiler has full modulating burner, an oil pump, and davited rear and front doors which expedite the tube removal and cleaning.



Controls on the boiler meet the code requirements of Underwriters Laboratories, Factory Mutual and Factory Insurance. The control system on the automatic units programs all burner and accessory functions from light-off to shut down.

The front and rear doors may be swung open after removing a few bolts at each end. Tube sheet and tubes are accessible for cleaning without removing the refractory, which is contained in the rear door. The doors are sealed with asbestos gaskets. Combustion air passes through the front head to keep the burner and control panel cool.

Totally enclosed, the control panel, located at the operator's level, contains the burner relay, blower motor starter, and control switches. An assembly containing both the electric and steam preheater is encased in a single shell. The boiler is Fiberglas insulated and then covered with 16-gage metal lagging.

More information? Circle Item 28 on postcard, page 101.

Fitting Prevents Leaks

A fitting that prevents leaks at pipe thread connections is announced by Tru-Seal Div., Flick-Reedy Corp., Melrose Park, Ill.

Named Tru-Seal, the seal-fitting is installed by threading it on pipe or fitting, threading pipe or fitting hand tight to the desired position in the port, and tightening the seal-fitting down against the pipe or fitting with only a light torque required.

Designed for use on dry seal or standard thread, the seal-fitting can be installed on oil, water, air, gas, steam, vacuum, and chemical fluid lines (except lines carrying fluorine gas or molten alkaline metals); for operating temperatures of −280 to 500 deg F and for pressures up to 3000 psi. It is recommended for use in applications where leakproof operation is absolutely essential; where pipe compounds might impair circuit operation; where space limits the use of large or long pipe wrenches; and on fittings that require frequent take-down and re-assembly.

More information? Circle Item 29 on postcard, page 101.

Automatic Steam Humidifier

Model No. VC-1, automatic steam type humidifier, for use in steam heated offices, conference rooms, apartments and other small room areas has been designed by Armstrong Machine Works, Three Rivers, Mich., to maintain relative humidity at a desirable level.

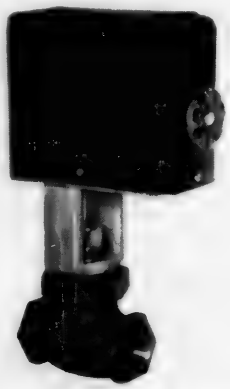
The humidifier connects directly to steam radiators or steam piping. Controlled by a humidistat, it disperses steam directly into the room atmosphere. Except for dead end service, condensate formed in the humidifier drains back through the supply line and no condensate drain trap is needed.

A 14-w solenoid valve controls the discharge valve enabling the humidifier to have a high capacity despite overall size of 9⅜ in.

More information? Circle Item 30 on postcard, page 101.

Two-Position Motor Valves

Two-position motor valves for the control of steam, water, gas, air, oil, or brine are manufactured by National Controls, Inc., Newton Centre, Mass.



Made for a static pressure of 150 psi, the valves are available in sizes from ¾ to 3 inches with bronze bodies and screwed ends and in sizes from 2½ to 6 in. with cast iron bodies and flanged ends with bronze trim.

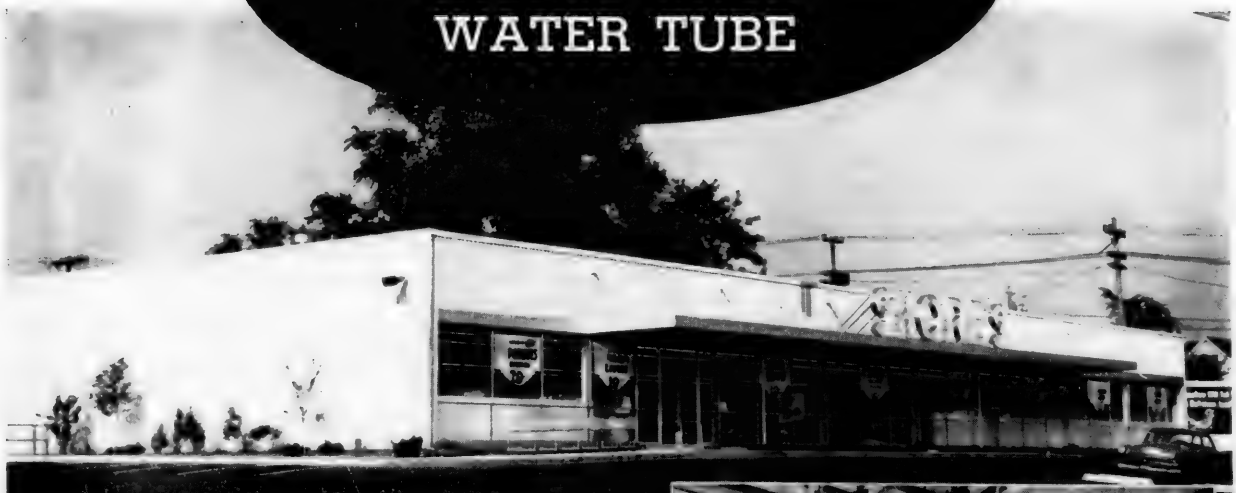
The limit switches and operating mechanism are powered by a shaped ring induction motor with a squirrel cage rotor. The cam operated limit switches are keyed to the cam shaft and control the on-off motor positions. Two auxiliary switches are furnished as standard for the control of additional valves and relays. A handwheel permits operation of the valve in the event of power failure.

The valve draws a control current of 2.2 amps and 25v. Its auxiliary switch rating is 5 amps.

More information? Circle Item 31 on postcard, page 101.

(*Continued on page* 118)

what they're saying about REVERE COPPER WATER TUBE



"There's nothing like it for running refrigeration lines, for economy and for ease of installation." says, William N. Harris, President
WILLIAM N. HARRIS, INC.
Pawtucket, R. I.

Architects: ESHBACH, PULLINGER, STEVENS & BRUDER. Consulting Engineer: A. ERNEST D'AMBLY, both of Philadelphia, Pa. Revere Distributor: R. I. REFRIGERATION SUPPLY COMPANY, Providence, R. I. Above photo shows compressor line-up in this 65-ton-capacity refrigeration layout. When you consider how long it would have taken if all the piping connections on this job had to be threaded, then you can readily understand why architects, contractors and engineers use Revere Copper Water Tube with soldered or brazed joints.

"As a refrigeration contractor I've found that nothing equals copper water tube for refrigeration and air conditioning lines. You can work in the tightest corners because the solder or brazed joints you make need no wrench room and you never have to worry about rust clogging the lines when you use copper tube. And because copper tube always makes a neat installation and is bright and shiny, you need never worry about exposing it. All things considered, copper costs less to install, too."

The words may be different, but we keep hearing the same saving story again and again. So why take chances? See your Revere Distributor for your copper water tube needs. And if you have technical problems, ask him to get in touch with our Technical Advisory Service for you.

Above photo shows insulated copper tube supply and return lines connecting cooling tower to compressors in Shore's Supermarket, East Providence, R. I. 2,500 FEET OF REVERE COPPER WATER TUBE in sizes from ½" to 3" were used. Refrigeration included storage room for frozen foods and meats, counter storage and sales areas.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N.Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

COPPER • BRASS • 18 01 • REVERE • ALUMINUM

(*Continued from page* 116)

Boiler Fires With All Fuels

A cast iron boiler for use with all types of fuels has been announced by Plumbing and Heating Div., American Radiator & Standard Sanitary Corp., New York, N. Y.

Designated A-7, the boiler is designed for commercial, industrial and institutional hot water or steam heating.

It is available in eight sizes, from five to twelve sections, and replaces the company's No. 36 water tube, the Nos. 4 and 5 Redflash, and the larger No. 3 Redflash boilers.

A steel base is available as an optional feature. The base eliminates the digging of a pit or the construction of a special fire brick base for automatic firing.

The boiler is designed for automatic firing with coal, oil, or gas but can be converted to hand firing with coal.

Its performance ranges from 2630 to 6380 sq ft net steam rating and from 4345 to 10,200 sq ft net hot water rating. The ratings are approximately the same for all fuels.

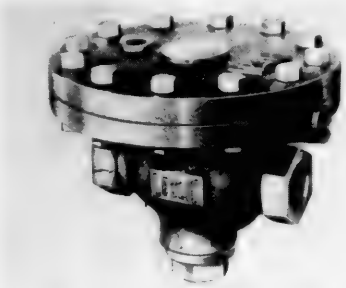
Special tappings are provided on the unit for external-type hot water heaters. There also are nipple port inspection tappings.

More information? Circle Item 32 on postcard, page 101.

Pressure Reducing Valve

A diaphragm operated, pressure reducing valve for steam heat and process steam applications is announced by Leslie Co., Lyndhurst, N. J.

Designated Class GPK, the valve has two moving parts —a metal diaphragm, with full valve travel, and a hardened stainless steel main valve that seats on a renewable. Stellited, seat ring.



An air loader replaces the conventional loading spring and produces a constant loading force on the diaphragm. The design assures the same control point over full valve travel.

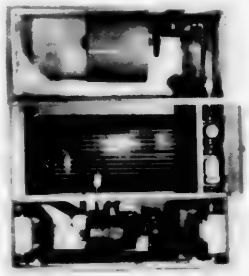
Made of cast iron, the valve is available in sizes from ½ to 2 in. with screwed end connections. Its inlet pressure range is 0 to 250 psi, 450 deg F. Used with the company's Class A air loader as illustrated or Type P panel mounted loader, the reduced pressure range is to 0 to 85 psi, or, up to 249½ psi with any suitable high pressure loader.

More data are available in Bulletin 561.

More information? Circle Item 33 on postcard, page 101.

Packaged Air Conditioner

An explosion-resistant package air conditioner for installation in hazardous areas, announced by Conditioned Air, Inc., Charleston, W. Va., is designed particularly for the chemical, petrochemical and petroleum industries and to the mining industries.



Packaged units will be marketed in 3, 5½, and 7½-ton sizes. They are suitable for installation in Class I, Group D areas.

The new units utilize Worthington hermetic compressors, condensers and coils. Each individual electrical component is approved and bears the National Board of Fire Underwriters label, except the motor, which is hermetic and under positive gas pressure. Motor leads are inspected and approved. Fans are of non-sparking construction with static conducting belts.

More information? Circle Item 34 on postcard, page 101.

Four Pumps in One

A vertical, multi-unit condensate pump is announced by Byron Jackson Pumps Div., Borg-Warner Corp., Los Angeles, Calif. The unit features four pumps in a common case and utilizing a common shaft.

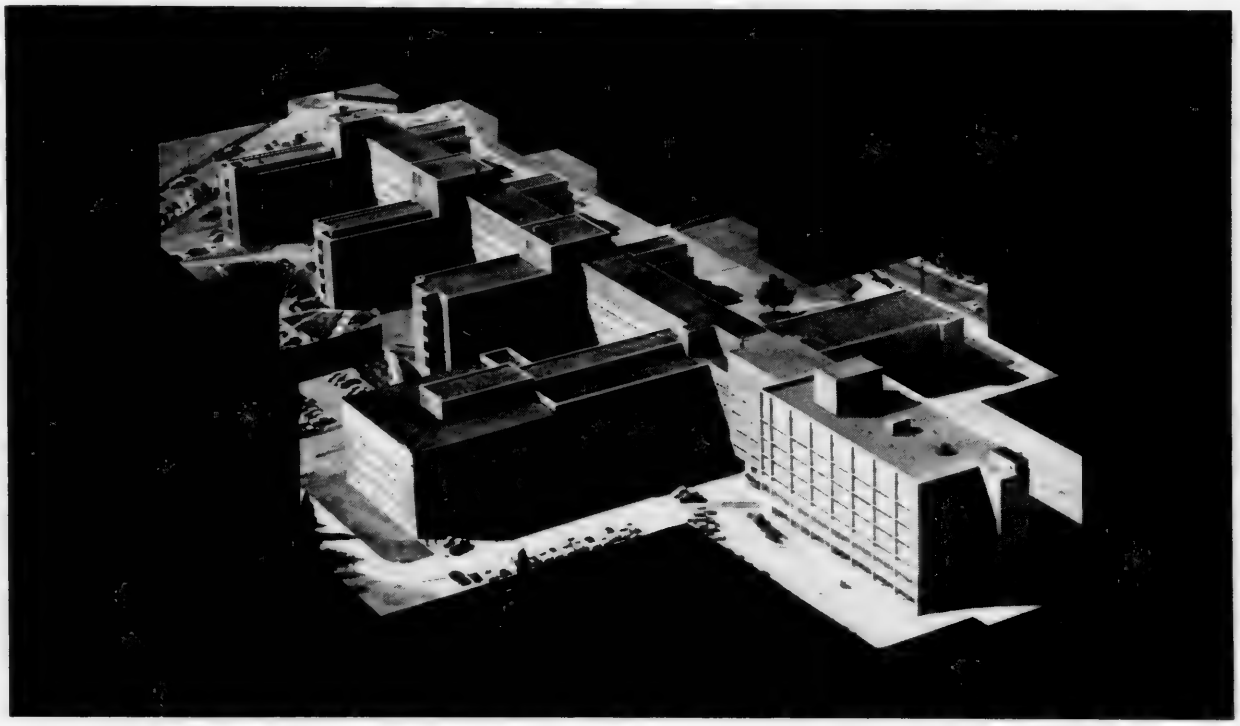
The four-pumps-in-one design was developed to save floor space in power plants, to obtain the economies of a common driver, and to reduce packing maintenance.

Three of the four pumps in each unit are single stage pumps, and the fourth is a two stage pump with an external crossover. The unit is driven by a vertical electric motor. Axial and radial hydraulic balance is obtained by using double suction impellers and double volute pump cases.

The outer casing is a vertically split type with the four sets of inlet and outlet nozzles located in one half to allow the removal of the rotating element without disturbing the suction or discharge piping.

More information? Circle Item 35 on postcard, page 101.

(*Continued on page* 119)



Architects: Narramore, Bain, Brady, and Johanson; McClelland and Jones
Professional Engineers: Bouillon and Griffith
General Contractor: J. C. Boespflug
Mechanical Contractors: University Plumbing & Heating
(Health Science Building) W. E. Beggs
Mechanical Contractors: Wenzler and Ward
(Teaching Hospital)

NEW JOB--
OLD STORY:

DURIRON®

ACIDPROOF PIPE

TO HANDLE CORROSIVE WASTES
AT UNIVERSITY OF WASHINGTON

DURIRON was the choice for acid proof piping at the new Health Science Building and Teaching Hospital at the University of Washington.

Certain advantages are obvious. DURIRON is the high silicon iron with resistance to corrosion, abrasion and erosion that architects have specified with confidence for more than thirty years. DURIRON is installed by ordinary plumbing methods. It generally outlasts the building; therefore, the first cost is the last cost. No finer recommendation can be made.

Always insist on DURIRON. Stocked by leading plumbing jobbers. Request Duriron Catalog PF/4 for details, or see Sweet's Architectural File.

THE DURIRON COMPANY, INC., DAYTON, OHIO

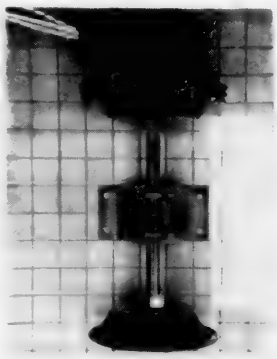
DURIRON
LOOK FOR THE NAME ON EVERY PIECE

(*Continued from page* 118)

Liquid Level Control

A liquid level control for applications requiring low levels or where the level height must be accurately maintained is made by The Henry G. Dietz Co., Long Island City, N. Y.

The sensitivity of the control is provided by a diaphragm which is operated by air pressure trapped in a cup-shaped-bowl immersed in the liquid. The switch can be made to operate on a minimum liquid level height of 3/8 in. A switch operating on this liquid level height will release when the water level is reduced by approximately 5/32 in.



The operating characteristics of the switch can be adjusted to customers' specifications in the factory. The connecting pipe, between the switch elements and the submerged bowl, can also be fabricated to suit customers' requirements.

Where necessary, other than the standard materials can be used in the fabrication of the bowl and pipe to insure the maximum corrosion resistance to liquids that are hazardous to the standard materials.

The electrical ratings of the single pole, double throw contacts are 15 amp. at 120-250v a-c and 1/8 hp or 125 volt-amperes pilot duty. Electrical connections are made with three color coded wires, which are sealed internally and are brought out through a 1/2-in., straight IPS female thread.

More information? Circle Item 36 on postcard, page 101.

Line of Water Coolers

A new series called the Constellation is added to the Oasis line of water coolers made by Ebco Mfg. Co., Columbus, Ohio.

A bottle model with a refrigerated compartment and hot and cold water dispensers is also added to the line. The refrigerated compartment is large enough to keep

bottled drinks, packed lunches, or even serums, biologicals, and pharmaceuticals clean and safe. It will also make and keep two full trays of ice cubes. It may be equipped with matched cup and beverage dispensers at slight extra cost.

The water coolers can provide water that is sufficiently hot for making instant coffee and other hot beverages and soups.

Each pressure model in the series has a stainless steel top which has been redesigned to facilitate water drainage. Included in the series are hand- or foot-operated models: capacities from 2 to 35 gal; standard or Hot'n Cold models, bottle or pressure models; and cafeteria or juvenile models.

More information? Circle Item 37 on postcard, page 101.

Line of Flexible Tubing

A line of bendable tubing known as Plica, is being made and sold in this country by The Flexaust Co., New York, N. Y., under rights acquired from Switzerland.

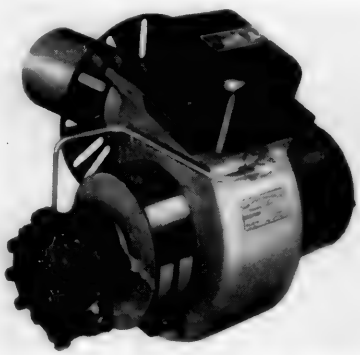
In Switzerland and other countries, the tubing has been used as electrical conduit. It can be in concrete, ceilings, and floors, can be cut with a hacksaw or knife, bent by hand, and fits standard connectors.

The tubing can be made of copper, brass, aluminum, steel, asbestos, fiber, paper, and combinations of these materials. It is used for lubricating, coolant and other non-corrosive liquid lines, hot and cold air ducts, mechanical protection and insulation of pipes, flexible shaft casing, and for a variety of other uses.

More information? Circle Item 38 on postcard, page 101.

Cast Aluminum Oil Burner

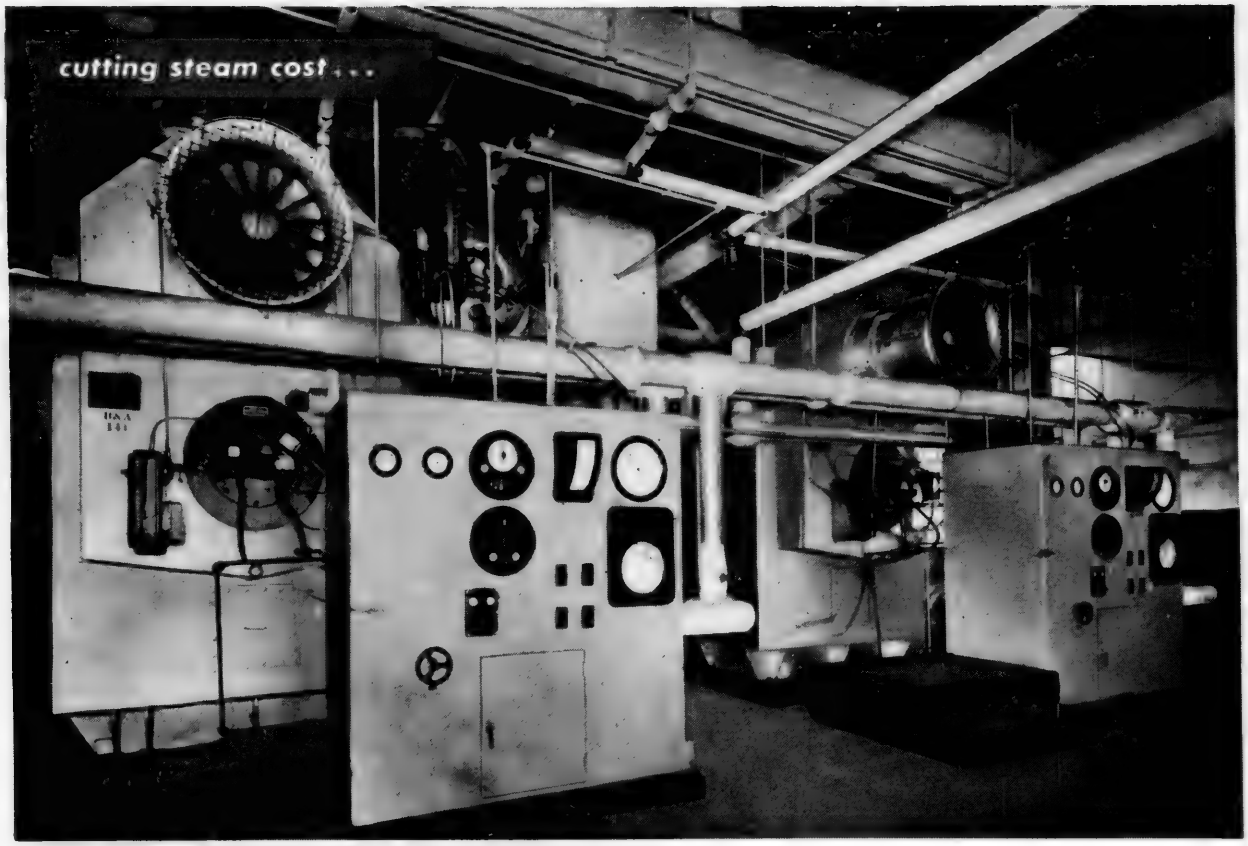
An oil burner has been designed for original equipment manufacturers by Sundstrand Engineering Co., Rockford, Ill. Constructed with a one-piece, cast aluminum housing, the unit will handle 0.75 to 1.65 gph of No. 2 oil, is available in tube sizes from 4 to 9 in., and can be supplied for either flange or pedestal mounting. It is listed as standard by the Underwriters Laboratories and is approved for Commercial Standards CS-75-56.



The complete specifications of the burner are issued by the manufacturer.

More information? Circle Item 39 on postcard, page 101.

(*Continued on page* 122)



—B&W FM Boilers *are workin' for the railroad...*

At the New York Central Railroad Station in Springfield, Mass., two B&W Integral-Furnace Boilers, Type FM have earned their reputation for being "good steamers all right" during the past two years. The units have been in service since September 1953, with time out each year during the slack summer load.

Springfield Station contains a sizeable area and handles a moderately heavy traffic load in both trains and people. Steam produced by the FMs is utilized, in season, to heat cars, station, and a warehouse almost a mile away, supply hot water for all purposes, and meet requirements of the restaurant and barber shop.

Usually operated at about 150 psi, each FM unit is designed to generate 20,000 lb. of steam per hr. During heavy winter load periods both boilers are operated. However, when the heating load is not the major factor, one unit carries the load, which averages around 12,000 lb per hr.

Fully automatic operation, with fuel-air ratio control, provides ready response and efficient combustion for fuel savings and smoke control.

Here in Springfield, as in many other installations of all kinds—for power, processing and heating, for institutions, utilities, industries, and commercial establishments—B&W Boilers are effectively demonstrating their versatility and suitability for a wide variety of applications. The FM Boiler is available in standard sizes to 40,000 lb steam per hr at pressures to 235 psi and many are in service at higher pressures and with moderate superheat. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

COST-SAVING FEATURES

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

BABCOCK & WILCOX

BOILER DIVISION

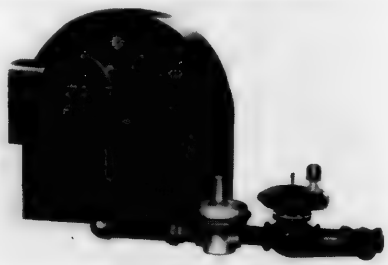
G-721

(*Continued from page* 120)

Industrial Gas-Oil Burners

Each model of a new line of combination gas-oil burners for industrial applications announced by Iron Fireman Mfg. Co., Cleveland, Ohio, has an integral air register, which eliminates the need for a checker floor.

The burner section and the air register, shipped as separate units, are bolted together on the job to facilitate installation on industrial conversion jobs.



The oil burner is the company's rotary cup burner, designed to fire with No. 6 or lighter oil. Oil burner ratings run from 9 to 125 gph.

The ring-type gas burner has multiple tubular stainless steel jets threaded into a heat-resistant cast iron manifold ring. It may be used with either natural or manufactured gas. Its capacities range from 1,650,000 to 13,750,000 Btu per hr input.

Change-over from one fuel to another is accomplished by operating a selector switch, or may be done by automatic controls.

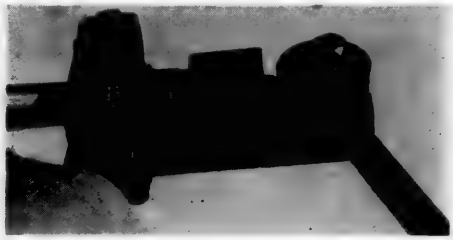
Electronic combustion controls automatically shut down the burner in case some abnormal condition arises. A programming control schedules the sequence of all burner operations. An automatic magnetic starter switch is provided for the oil burner motor.

More information? Circle Item 40 on postcard, page 101.

Tool Flares Tubing

A tool, named Spe-D-Flare, which produces a flare in the end of copper tubing is being manufactured and marketed by William L. Engesser & Co., El Monte, Calif.

The flaring operation is accomplished in three steps: 1—Open the tool and place the copper tubing against the flaring pin. The tube adjusts automatically to the proper



height above the holding jaws. 2—Close the holding jaws and hold the handles firmly together. 3—Close the compression cam handle (see illustration) which moves the flaring pin against the copper tubing. When the tubing is taken out, it is ready for use.

The flaring pin is aligned with the tube to be flared because the boring of the hole through the holding jaws and the hole for the flaring pin pressure rod is one continuous operation.

Weighing 1½ lb, the tool is about the size of an average pair of pliers. An attachment converts it from a hand tool to a bench tool so that it can be permanently mounted on a work bench for higher production; however, the hand model is clamped in an ordinary bench vise, it can also become a production bench model with the added advantage of being able to remove and store it in a more convenient place. In addition to copper tubing, the tool can flare a number of grades of aluminum tubing.

Five sizes are currently available: 1/4, 5/16, 3/8, 7/16, and 1/2 in.

More information? Circle Item 41 on postcard, page 101.

In-Line Water Filter

An in-line water filter, the Model C Flo-Clear, is introduced by Filtros Inc., East Rochester, N. Y.

A third model in a line of filters, the new unit can be installed at any convenient location inside or outside a building. The porous ceramic filtering unit is fastened inside an extruded aluminum shell and bolted to a cast aluminum top that is tapped for standard pipe threads. All the aluminum parts are covered with a plastic coating to resist corrosion.

The filter is available in three sizes with ¾, 1, and

1¼-in. pipe openings. The ceramic units are available in fine, medium, or coarse pore sizes for each size pipe opening.

When the filter is installed in the supply line ahead of the pump, all water must pass through it before reaching the pump. The filter will trap and filter out suspended foreign matter such as sand, grit, and algae, preventing it from reaching the pump's precision working parts.

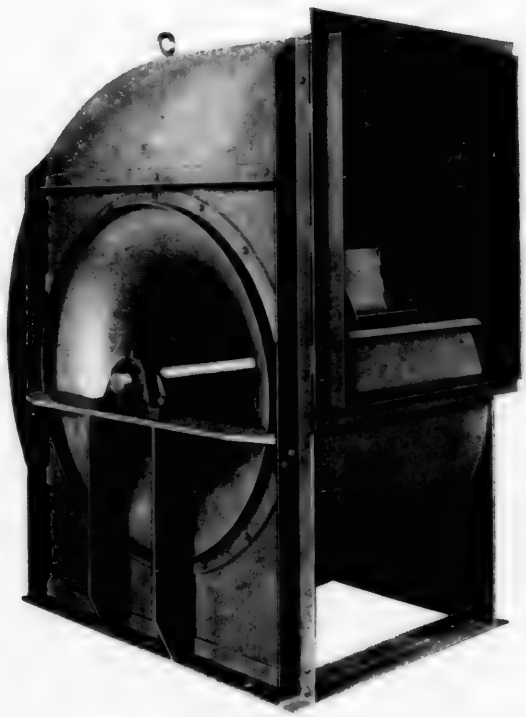
Cleaning can be done by backwashing under maximum flow with the bottom drain plug removed. An alternate method is to keep a spare ceramic filter unit on hand, which can be substituted for the dirty one in a few minutes; the dirty filter can be cleaned when convenient.

More information? Circle Item 42 on postcard, page 101.

(*Continued on page* 124)

nyb centrifugal fans...

STANDARD AND HEAVY DUTY



Skillfully Engineered, Accurately Rated, Feature Heavy Welded Steel Construction

Two types of fan wheels. Housing dimensions remain the same but performance characteristics differ.

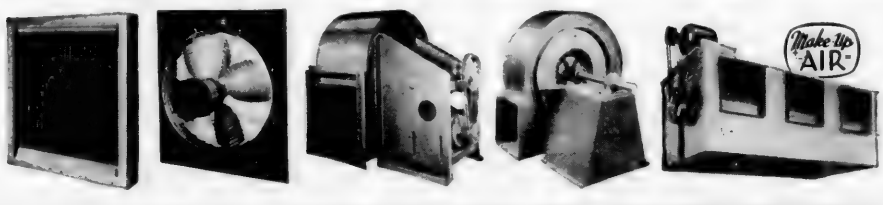
Forward Curve wheels offered from 7½ to 73 inch. Capacities up to 70,000 cfm.

Quiet operating, medium speed (IPL) wheels with non-overloading horsepower characteristics for heating, ventilating and air conditioning or industrial applications. Wheel diameters from 15 inch to 73 inch, with any speed or discharge required. Capacities up to 123,000 cfm. Class I, II, or III construction.

All-welded housing featured as standard construction for simplicity, extra strength and rigidity—dust tight and leak proof. Bolted (knock-down) type available in Class I and Class II. Split housing can be furnished as extra if required.

Write for Bulletins 544 and 561

nyb products have 65 years of manufacturing experience and engineering knowledge built into them. All **nyb** products are laboratory tested, accurately rated and fully guaranteed in strict accordance with standard test codes.



When working on your air handling problems, consult the *nyb* representative nearest you in our nationwide service or write for bulletins.

nyb **THE NEW YORK BLOWER COMPANY**

SALES OFFICES • 3165 SOUTH SHIELDS AVENUE • CHICAGO 16

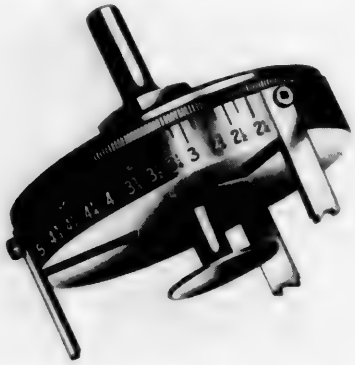
FACTORY, LAPORTE, INDIANA

(*Continued from page* 122)

Industrial Hole Cutter

An industrial wood and metal working tool, called Dial Saw, for use with heavy duty equipment is available from Robertson and Ruth, Elmhurst, Ill.

With the use of dial settings, the tool cuts holes from 2¼ to 5 in. in diameter. A turn of the calibrated dial sets the high speed, steel, cutter blades to the diameter desired.



Made from high alloy steel, with a black rust-resistant finish, the tool is available in three shank types: Model 500 with a ½-in. straight shank; Model 500A with a ¾-in. straight shank; and Model 501 with a Morse No. 2 taper shank.

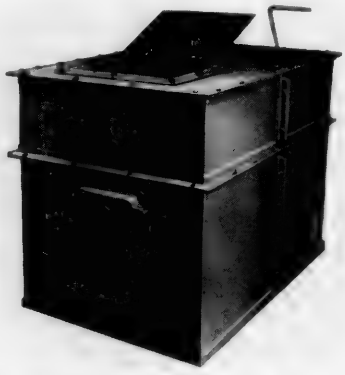
Each saw is furnished with a ½-in. pilot drill and push-out plug, which are interchangeable, and two sets of high speed steel cutter blades—one set with a cutting depth of 1½ in. for wood cutting and another set with a cutting depth of 1¼ in. for metal cutting.

A brochure describing the full line of saws for industrial, standard duty, and heavy duty use is published by the manufacturer.

More information? Circle Item 43 on postcard, page 101.

Commerical Incinerator

A commercial heavy duty incinerator with double secondary combustion and settling chambers is added to the line of packaged factory prefabricated incinerators made by Brule Incinerator Corp., Chicago, Ill.



Models are available self-fueled, with gas or oil blower burners, and safety and electric ignition. Venting is recommended through refractory lined flues or stacks for safety from heat and for controlling temperatures in loading areas.

To install the unit, bolt the two incinerator sections together and set in the grates, the equipment is then ready for venting and operation.

More information? Circle Item 44 on postcard, page 101.

Coating for Galvanized Metal

A metallic coating called Metco has been developed by Solfo Paint Mfg. Co., Trenton, N. J., to prevent paints, lacquer, enamel, or other siccative coatings from peeling off the surfaces of galvanized metal.

Colorless, non-flammable, and odorless, the coating may be applied by brush or a cloth saturated in the solution. It may also be used as a bath in which to dip a product to be coated and reacts on soldered joints the same as on a galvanized surface and may be soldered over the finish.

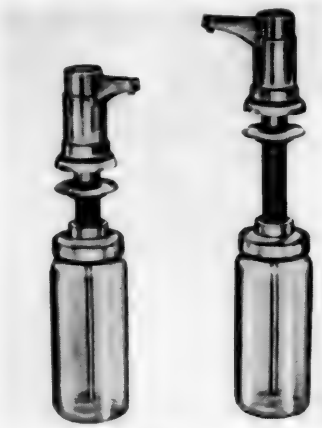
A sample bottle with sufficient quantity to cover 40 sq ft is available on request.

More information? Circle Item 45 on postcard, page 101.

Soap Dispensers

Basin-type soap dispensers are announced by American Dispenser Co., Inc., New York, N. Y.

Often called Pullman type, the dispensers are suitable for installation in public washrooms where wall space over basins is limited. They are installed on the washstand itself by inserting the dispenser's shank through a 1-in. hole in the basin, with the globe safely out of the way under the basin. Many installations are also made where the hot or cold water tap has been removed.



Inasmuch as the dispensers are filled from the top, handling or breaking glass globes under the basin is eliminated. They are also available with chromium plated metal globes at slightly higher cost.

The dispensers are manufactured with straight liquid or lather-forming soap valves and are available with 3- or 4¾-in. long shanks to fit all basins. Metal parts in contact with the soap are made of stainless steel to eliminate verdigris and sticking.

More information? Circle Item 46 on postcard, page 101.

(*Continued on page* 126)

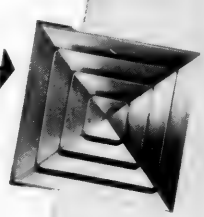
air patterns unlimited without blank-offs

AGITAIR® *Custom Made*

AIR DIFFUSERS with DIFFUSING VANES

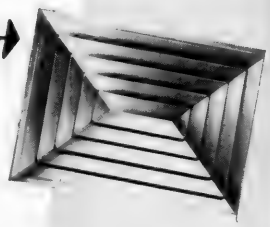
. . . better because

A good piece of equipment is no better than the experience behind it.



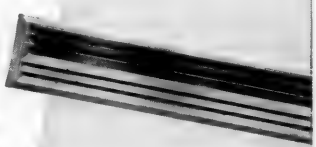
. . . better because

It's the original square and rectangular outlet . . . not just a poor imitation without distinctive features.



. . . better because

The company behind these diffusers has a history for doing things right and guaranteeing results.



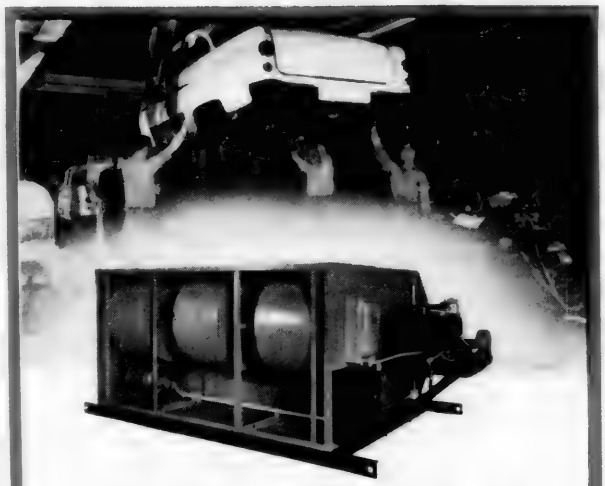
you can depend on AGITAIR *for better air*

Your local AGITAIR representative will gladly assist you in selecting the proper size and air pattern to meet the requirements of your job. In addition, the engineering staff and laboratory resources of Air Devices Inc., are available to you.

AIR DEVICES INC.

185 MADISON AVENUE NEW YORK 16, N. Y.

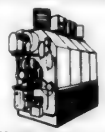
Air Diffusers • Filters • Exhausters



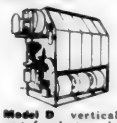
LEADING AUTOMOBILE MANUFACTURERS place their confidence in

NATIONAL *Champion*

DIRECT FIRED HEATERS

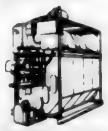


Model H vertical unit with discharge heads 12 sizes

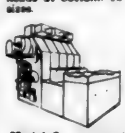


Model D vertical unit for duct work. 12 sizes

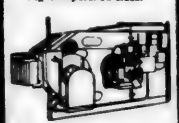
Model P — portable, vertical unit for flexible duty 6 sizes



Model R — inverted unit with discharge heads at bottom. 12 sizes.



Model S — vertical unit with side blowers to permit proper location of air mixing dampers. 12 sizes.



Model C — horizontal ceiling suspension unit for space saving. 12 sizes.

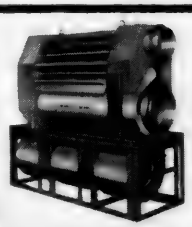
Where make-up air and tempering is a problem — a National Champion heater is your answer.

And where space is a prime consideration, the National Champion Model C horizontal ceiling suspension unit is unexcelled. No matter how large or small your plant may be, there's a National Champion heater designed to do the job with the utmost economy and efficiency. All National Heaters feature the lifetime "teardrop design" stainless steel combustion chamber. National Champions come in 6 models — 66 sizes, from 200,000 to 2,000,000 BTU capacities. Check these outstanding features.

- 80% guaranteed heating efficiency
- Direct fired for gas, oil or combination fuels
- Completely automatic controls — for constant, clean heat
- 0% to 150% more heat transfer area than most similar units.
- Quieter, smoother operation — lowest blower RPM
- Highest available external static pressures
- Electronic flame failure control
- Completely wired, assembled and flame-tested at the factory to guarantee peak performance
- Listing by Underwriters' Laboratories, Inc. and approved by American Gas Association

Write today for complete information and specifications

ASK FOR BULLETIN A



Teardrop design Combustion Chamber the "heart" of National Champions

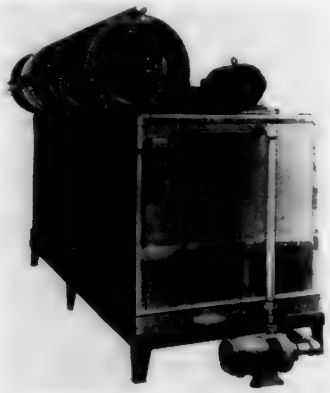
NATIONAL HEATER CO., INC.

2180 Cleora Ave. St. Paul 4, Minn.

(*Continued from page* 124)

Cooling Towers Have Dampers

Cooling towers, called Recold Dri-Fan, with automatic modulating dampers for the control of water temperature are available from Refrigeration Engineering, Inc., Los Angeles, Calif. The dampers provide a method of adjusting the capacity of the unit to match the capacity of the compressor when the system is operating at any condition from full to minimum capacity.



A constant water temperature, to keep the head pressure from going too low, is maintained by the addition of modulating dampers to the cooling towers. The dampers may be controlled by a thermostat which operates a modulating damper motor. An end switch cuts off the fan motor when the dampers are completely closed. This regulates the amount of air through the tower and keeps the water temperature constant.

The dampers have opposed action balanced blades and are connected internally by suitable hardware.

The cooling towers blow air through the unit instead of pulling air through the fan section. This eliminates saturated air from the fan section and removes the cause of excessive rust and corrosion in this area.

More information? Circle Item 47 on postcard, page 101.

Piping Markers

Vinylite plastic pipe markers for the identification of indoor and outdoor piping are placed on the market by Wilmington Plastics Co., Wilmington, Del.

Color-coded to conform to the American Standard of pipe identification, the markers come in one- or two-word descriptions indicating the gas or liquid being transported in a pipe line.

The legend is printed on light, fast-colored paper, which is completely enclosed in a plastic that is laminated between two sheets of Vinylite and formed to completely encircle the pipe. The overlapping edges are cemented to each other and form a cylinder around the pipe so that the marker will not fall off or be put back on the wrong pipe line.

For hazardous or dangerous materials a yellow background with black printing is suggested. Fire protection on red; safe materials on green backgrounds and so on. Various colored printing can also be used on the colored backgrounds.

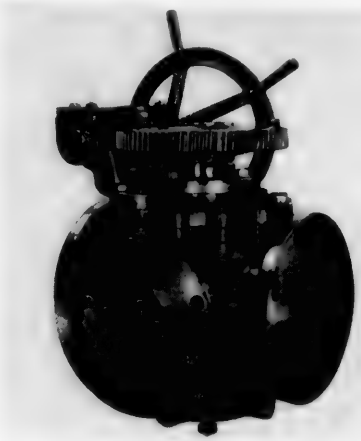
The markers specifically indicate what is being conveyed in the pipe line, for example: sulfuric acid, process water, drinking water, boiler feed water, or whatever properly identifies the material. The printing of the marker is so arranged that it can be read from any direction.

Markers are available for pipes as large as 30 in. in diameter and as small as ¼ in. The length of the marker is determined by the amount of letters in the legend.

More information? Circle Item 48 on postcard, page 101.

Valves Have Worm Gearing

An addition to the standard line of jacketed valves and fittings made by Parks-Cramer Co., Fitchburg, Mass., is optional worm gear operation of jacketed plug valves from 3 to 8-in. in 2- and 3-way types. The 8-in. valves, the largest currently available, are most easily operated with worm gearing.



The gear operators are supplied with stops at 90 or 180 deg of rotation. Indicators on the gear and top of the plug show the position of the port openings in relation to the body. All of the valves are normally supplied not lubricated, but lubricated valves are available on order.

More information? Circle Item 49 on postcard, page 101.

Clamp Welds Pipe

A clamp for patch-welding pipe is manufactured by Atlas Industries, Inc., Houston, Tex.

For pipe up to 6 in. in diameter, a saddle type tool is available. A chain type tool is made by the company for pipe from 7 to 36 in.

Made of steel and Neoprene, the patch is an integral part of the clamp, which is constructed of steel. A circular indentation is partly countersunk into the outside metal surface of the patch to serve as a pivot for the screw and to prevent the patch from creeping. The patches are secured by electric arc welding without requiring purging or emptying the pipe. They may also be cold welded to the pipe.

More information? Circle Item 50 on postcard, page 101.

(*Continued on page* 128)

EXHAUST...

WHEN You Want It
WHERE You Want It

FOR EVERY INDUSTRIAL APPLICATION

with FLEXAUST® hose

In a large midwestern chemical plant, 12" I.D. Flexaust Hose is used to exhaust fumes and heat from a flame-cutting operation. The hood to which the Flexaust hose is attached is carried on a movable boom, putting the exhaust exactly where it is needed. Available in 1¼" to 36" I.D.

EASY TO INSTALL

• Unskilled labor can cut and install Flexaust duct quickly and easily. A set-up like this one can be easily installed and just as easily moved to meet changes of process or relocation of machines. It can be cut to any length, and is easily coupled to any other duct work.

HIGHLY FLEXIBLE

• No layout problems with Flexaust! Made of nylon or cotton base impregnated with age-resistant Neoprene compound and reinforced with spiral wire, it will not kink or flatten. It maintains its cross-section even on sharp bends. As it has excellent lengthwise compressability, it is easy to transport and store.

LONG LASTING

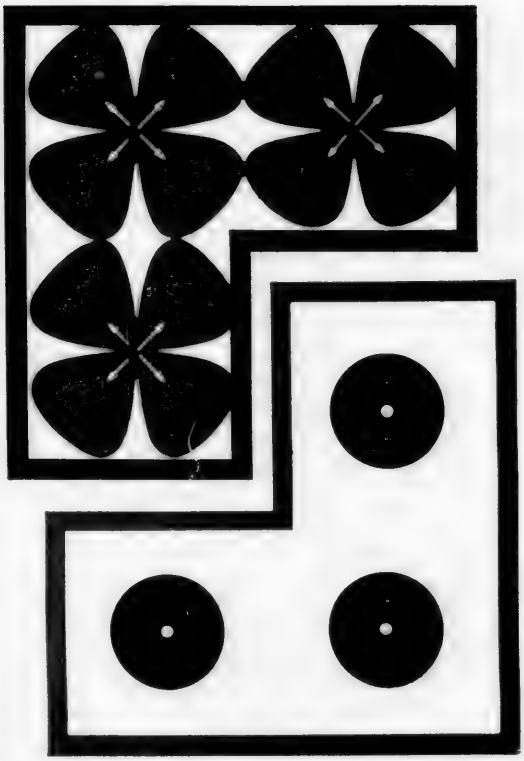
• Flexaust is highly resistant to corrosion, moisture, chemical deterioration and flexing fatigue. Its bonded, double ply, double overlap construction makes it fully air-tight for pressure, suction or gravity operations. It outlasts other types of ducts in handling abrasive dusts as in grinding, materials handling, etc.

You can use Flexaust for fume exhaust, for dust or chip collection, for ventilation, for handling of bulky materials. In every application it proves its economy in first cost and simplicity of installation . . . its efficiency in its performance and adaptability to all types of jobs. Also available, retractable type Portovent duct.

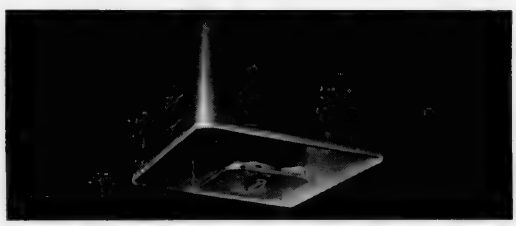
Write today for bulletins giving complete data on flow characteristics, installation procedure, sizes, fittings and accessories.

THE FLEXAUST COMPANY

Dept. HV-8, 100 Park Avenue, New York 17, N. Y.
Formerly American Ventilating Hose Co.
Stocks are available from coast to coast



"Clover leaf" heats 70% more space



Three of Carrier's new 4-way Unit Heaters with "clover leaf" air distribution cover over 80% of this 100-foot-wide building. Three projection-type heaters of equal capacity with circular air patterns cover 10% of area!

Carrier's exclusive "clover leaf" air pattern discharges heat in four directions over areas up to 108 feet in diameter. Simple adjustments vary air pattern. No outlets to change. No accessories to add. Extra coverage means fewer units, installation and operating savings.

Carrier 4-way Unit Heaters, for use with steam or hot water, come in 8 sizes: 55,000 to 600,000 Btu/hr. Look in your Classified Telephone Directory for the name of your Carrier jobber-distributor.

Complete Line of Unit Heaters. With over 50 years' leadership in temperature control, Carrier knows heating. Carrier Corporation, Syracuse, New York.

Carrier

industrial heating
air conditioning • refrigeration

(*Continued from page* 126)

Device Detects Dust

An automatic dust detector, for measuring and controlling dust in rooms that require a high degree of cleanliness, has been designed by Phoenix Precision Instrument Co., Philadelphia, Pa.

A few typical applications of the detector include hospital operating rooms and assembly rooms maintained by manufacturers of precision instruments, bearings, and electronic equipment.

As described by the manufacturer, the sensitivity of the unit is such that if a layer of dust one thousandth of an inch thick, contained on the head of a nail (head diameter ¼ in.), is uniformly dispersed in a dust free room 8 by 10 by 15 ft, the dust detector responds with a meter deflection 20% of full scale. It can also handle heavy dust loads that would approximate a fog reducing visibility to thirty feet. This range is obtained on a single scale (without making sensitivity adjustments) through logarithmic amplification.

More information? Circle Item 51 on postcard, page 101.

Packaged Boiler

The Progress packaged boiler designed to simplify boiler planning and installation was introduced by Cleaver-Brooks Co., Milwaukee, Wis., at the National Plumbing and Heating Exposition recently held in that city. Features found in the company's industrial boilers such as complete package, forced draft, four pass design,

complete factory testing and field starting service, are incorporated.

The unit is designed for schools, churches, apartment buildings or for commercial applications in the 500,000 to 2,000,000 Btu per hr range. At present it will be manufactured in five sizes, both oil and gas fired types.

The ASME boiler in addition to a hydrostatic test is fired at full rating at the factory and undergoes an electrical component check.

More information? Circle Item 52 on postcard, page 101.

Urinal Seam Cover

A vitreous china seam cover for multiple installations on urinals is being marketed by Universal-Rundle Corp., New Castle, Pa.

The seam cover's finish is fired at high temperatures to produce a safe, sanitary surface between urinals. Specifically designed for use between stall urinals, it resists chipping, staining, scratching and crazing.

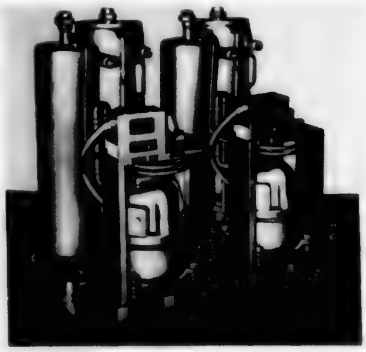
The shipping weight of the covers is approximately eighteen pounds. Urinals ordered for battery installation with the seam covers should specify side grinding. The new seam covers are available in white or decorator colors.

More information? Circle Item 53 on postcard, page 101.

Packaged Liquid Chillers

A line of packaged liquid chillers for commercial and industrial applications from 5 to 25-hp is made by A. Brown Products Corp., Forest Hills, N. Y.

Named Mono-Aqua, the units are assembled in multiples of 5 tons. Each 5-ton section shuts itself off automatically as cooling requirements vary or are reduced.



This reduces electrical consumption and provides stand-by cooling in the event a unit is out of order.

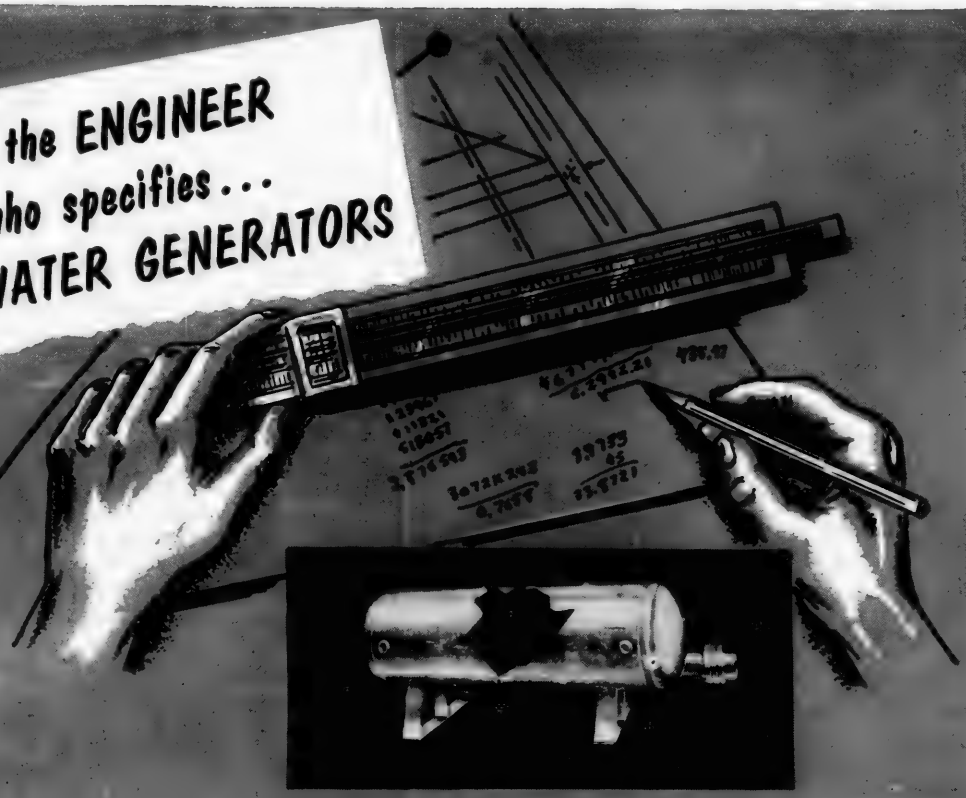
The controls permit rotation of the operating sequence of individual increments, thereby resulting in a longer overall service life. The refrigeration mechanism is entirely hermetically sealed.

Installation of the units requires only electrical power and standard water piping connections.

More information? Circle Item 54 on postcard, page 101.

(*Continued on page* 130)

To the ENGINEER
who specifies...
HOT WATER GENERATORS



A New Concept for Longer Life

The life and satisfaction of a Hot Water Generator depends on three factors; 1) proper sizing of vessel, 2) proper sizing of heating element and source of heat, 3) reducing corrosion to a minimum. Incorrectly calculating any of these factors might make early replacement of the unit necessary.

Today, NOVELTY offers a new concept of corrosion resistance—the new NOVELON Baked-on Plastic Lining. This new multi-applied, phenolic resin coating is the most successful anti-corrosion measure ever developed for steel vessels. It is low in initial cost; heat resistant—up to 500° F.; leaves a smooth, non-porous surface that is easy to clean; imparts no color, odor or taste—particularly rust-color; and will not deteriorate with age.

When specifying Hot Water Generators, Heat Exchangers, Air Receivers, Storage Vessels and Novelon Linings, let NOVELTY'S Engineering and Sales Departments help you specify the correct vessel to meet your needs. Let our 50 years of experience be your assurance that the vessel you specify is the best, most advanced vessel available.

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Write today for 34 page reference catalog.

"Specify NOVELTY or Equal"

NOVELTY
STEAM BOILER WORKS, INC.
CLARE AND KLOMAN STREETS
BALTIMORE 30, MARYLAND

HOT WATER GENERATORS

STORAGE TANKS

SPECIAL LININGS

SPECIAL FABRICATION

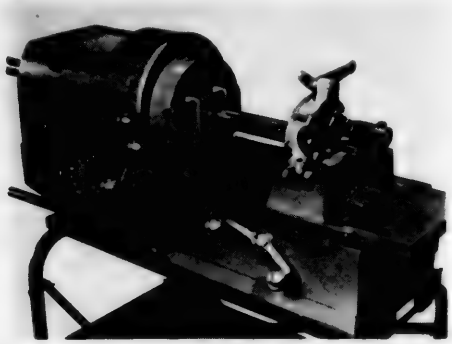
NOVELTY STEAM BOILER WORKS, INC. REPRESENTATIVES IN MAJOR CITIES.

(*Continued from page* 128)

Portable Pipe Threader

A portable pipe, conduit, and bolt threader and cutter is made by Collins Machinery Corp., Los Angeles, Calif.

Named the Thread-O-Matic 22, the machine has an automatic, power-operated double chuck. It threads pipe or conduit from ⅛ to 2 in. and bolts from ¼ to 1½ in.



A sliding extension bar on the machine enables the operator to break tight fittings. Pipe is guided into the spindle by the funnel-shaped design of the rear cover. The tool tray on top of the housing offers greater working convenience. The spindle bearings are lubricated by a continuous feed of oil from individual reservoirs.

Standard equipment of the machine includes three quick-opening, scroll die heads, with a separate reamer assembly, or six quick-opening, frame die heads with built-in reamers for threading ½- to 2-in. pipe. Both types of die heads have an automatic, coolant oil, flow system to prevent damage from operator's forgetfulness and to prolong the die's service life.

More information? Circle Item 55 on postcard, page 101.

Solenoid Valve

A 2-way, direct, solenoid controlled valve that is designed to be installed in-line is made by Airmatic Valve, Inc., Cleveland, Ohio.

To facilitate inspection and maintenance, all control parts can be removed in one small assembly, without disturbing the piping, by loosening one hexagonal nut.

Primarily for alternating current applications (both pressure and vacuum), the normally closed valve is available in standard pipe sizes from ¼ to 2 in. Having only two moving parts, it has a high-speed action with a short plunger travel.

Non-corrosive throughout, the valve can be controlled by a relay or a microswitch, allowing the designer the choice of a complete electrical system. It can be mounted in any position and operated continuously without harm to the valve or the solenoid.

More information? Circle Item 56 on postcard, page 101.

Pump Ends Are Made of Plastic

A plastic material for corrosion-resistant liquid ends is being used by Milton Roy Co., Philadelphia, Pa., for its controlled volume pumps and chemical feed systems.

Known as Plio-Tuf, the material is a resin compound

and is inert to many chemicals which cannot be handled by alloys. In addition, where other chemicals can be handled by both an alloy and the plastic, the cost of the Plio-Tuf end is usually less than that of the alloy.

The relatively low cost of the plastic liquid ends is partly due to the fact that the plastic, which is manufactured by the Goodyear Tire & Rubber Company, can be molded and does not have to be extensively machined. It can be used on pumps with plunger diameters up through 1⅛ in.

The recommended ranges of use of the plastic liquid ends are: pressure, 150 psi; capacity, 70 gph; and temperature, 160 deg F.

More information? Circle Item 57 on postcard, page 101.

Hot Gas Pyrometer

An instrument for measuring the temperature of hot gasses in difficult situations where the gas temperatures and surroundings are constantly changing is introduced by Fielden Instrument Div., Robertshaw-Fulton Controls Co., Philadelphia, Pa.

Called a Land suction pyrometer, the instrument measures the temperature of heated gas from 0 to 2900 deg F. It can be used in water tube boiler furnaces; uptakes and regenerators of open hearth furnaces; glass tanks; and other industrial and laboratory applications.

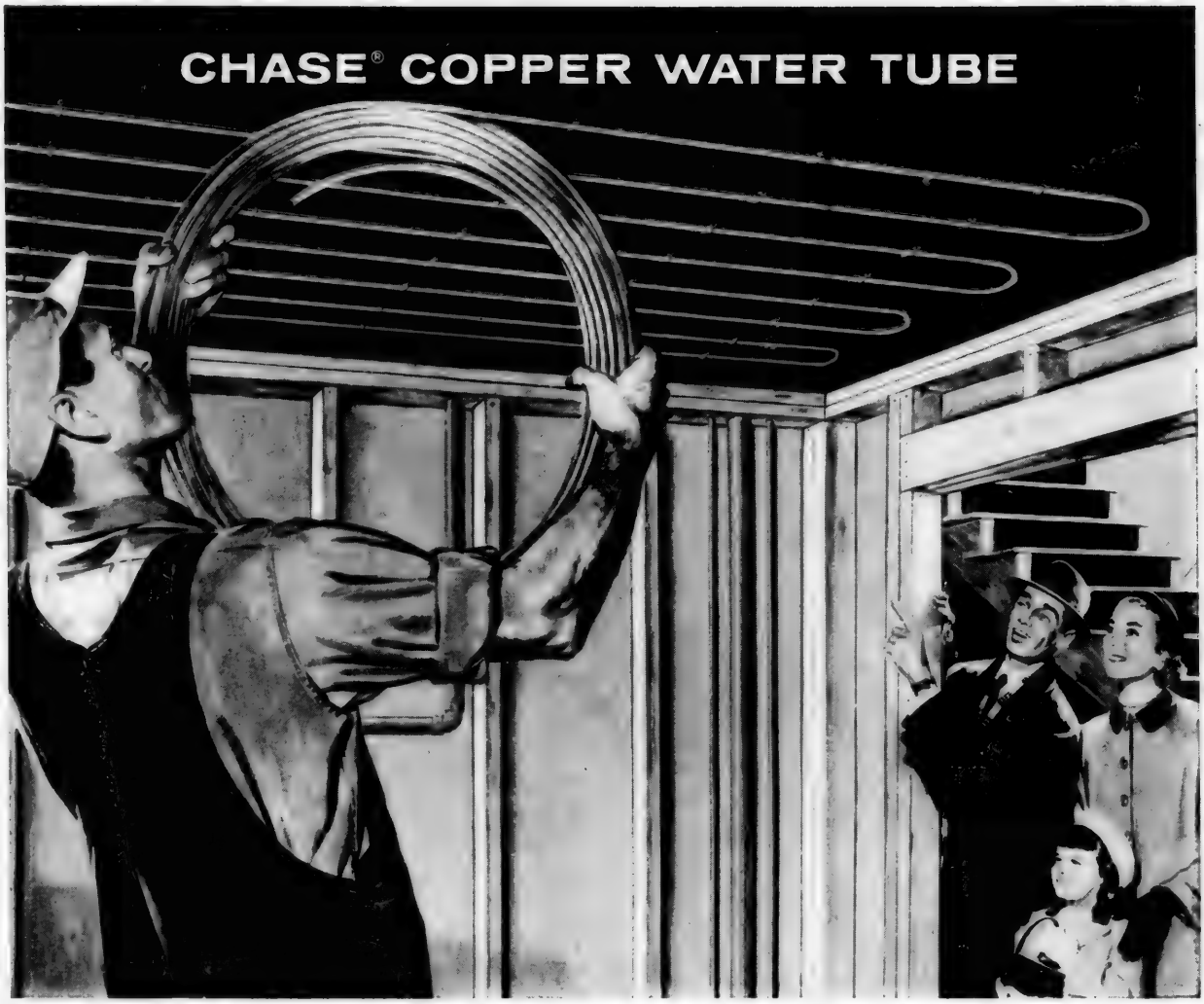
Suitable indicating and recording instruments can be used in conjunction with the suction pyrometer, and the company will provide complete systems wherever required. Three models are offered using platinum and platinum-rhodium sensing elements, each designed for a particular application and temperature range.

In operation, the device forces hot gasses at high velocity past thermocouples in order to increase the convective heat transfer from the gas. Concentric shields are employed to protect the temperature sensing elements from disturbing external influences.

The main unit consists of a water-cooled stainless steel jacket, which is 6 ft in length. However, the company said it will supply lengths from 4 to 12 ft. A platinum thermocouple with 5 ft of spare wire in a reel box is also part of the suction pyrometer.

More information? Circle Item 58 on postcard, page 101.

(*Continued on page* 132)



NO CEILING ON COMFORT HERE !

But, plenty of ceiling on cost!

That's because lightweight, easy-handling Chase copper tube for radiant heating *installs faster!* Perfectly tempered, it easily unrolls into position on ceiling or floor. Comes in long 60 and 100-foot lengths that result in fewer joints. Connections are quickly made with simple soldering techniques.

Even the rugged carton for Chase copper water tube is designed to speed handling...save time! It's color-coded for easy identification of type and size. Has a center hole big enough for a firm grip. Can be stacked, rolled or carried with ease!

Proof that Chase copper water tube cuts installation time is the fact that it is being used in many of the largest housing developments where over-all costs *must be low!*

If it's radiant heating, be sure the system is made with Chase copper tube and solder-joint fittings.

Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

(*Continued from page* 130)

Piping Compensator

A piping compensator is made by Rotherm Engineering Co., Inc., Chicago, Ill., to take care of strains in steam, air, hydraulic, and refrigeration pipe lines.

Available in sizes from ½ to 6 in. to any suitable length, the unit consists of two ball seats individually spring seated so that movement can be had in all directions including unlimited traverse expansion. All internal parts are corrosion resistant and sealed with seals that will not adhere to the metal.

Examples of the units applications include: Pipe lines on the end of larger paper dryers, for expansion, aboard ship where there is considerable piping strains, for earth quake piping, for setting of buildings and large storage tanks.

More information? Circle Item 59 on postcard, page 101.

Monitor Stops Vibration Damage

A vibration monitor is made by The Beta Corp., Richmond, Va., to anticipate and prevent trouble in rotating and reciprocating machines by responding to slight increases in roughness or vibration and causing a shutdown before a costly failure occurs.

Examples of detectable malfunctions are failing bearings, bent shafts, unbalance, and broken blades.

Named Model 5 Vibraswitch, the monitor's applications include pumps, motors, compressors, blowers, gas engines, diesels, centrifuges, turbines, generating equipment, and test stands. It may be used singly on small

equipment in pairs on driving and driven equipment, or in series or parallel combinations to monitor each bearing. Its acceleration range is 0-2 G's to cover rotating equipment at speeds up to 18,000 rpm.

The unit has a shock-free holding and reset mechanism for automatic or remote operation to prevent actuation from starting or from normal or accidental transient shocks. It employs no vacuum tubes or electronic components and is supplied in an explosion proof housing for Class I, Group D; Class II, Groups F and G locations, or gasketed for non-hazardous outdoor locations. The housing is made of cast aluminum threaded for ¾-in. conduit. Terminals are provided for a heater resistor to prevent condensation in semitropical or tropical climates.

Switch contacts are SPDT, split-contact NO, or split-contact NC rated at 7 amp up to 440v, a-c. Reset-holding coils are available for 6, 12-16, 24, 48, and 115v, a-c. The coil power is 5 watts on intermittent duty.

More information? Circle Item 60 on postcard, page 101.

Adjustable Slotted Diffuser

A series of slotted air diffusers for interiors requiring a linear type of outlet is made by Connor Engineering Corp., Danbury, Conn., to provide control of both air volume and air direction.

The adjustable grid-type damper regulates air volume over the entire diffuser length, and the hinged extruded aluminum vanes can be positioned for any angle of air discharge.

The slotted series is available in two models, KSL-1 for single air stream discharge in 3½ and 6-in. widths, and KSL-2 for multi-directional discharge and greater capacity in a 12-in. width. Both models are made in 2, 3, 4, and 6-ft modules.

By omitting the end flanges at each joint several may be installed end to end to form a continuous diffuser line in a wall or ceiling. Their capacity is from 50 to 300 cfm per ft of length, depending upon the model and space to be served.

Selection and performance data are contained in Bulletin K-27.

More information? Circle Item 61 on postcard, page 101.

Drainage Pipe

A drainage pipe known as Chem-Weld is introduced by Southwestern Plastic Pipe Co., Mineral Wells, Tex.

The pipe is made from a material that is unaffected by most acids and alkalis and is not subject to rust or elec-

trolytic corrosion. Joints are made by a cement that brings about a fusion of the pipe to the fitting.

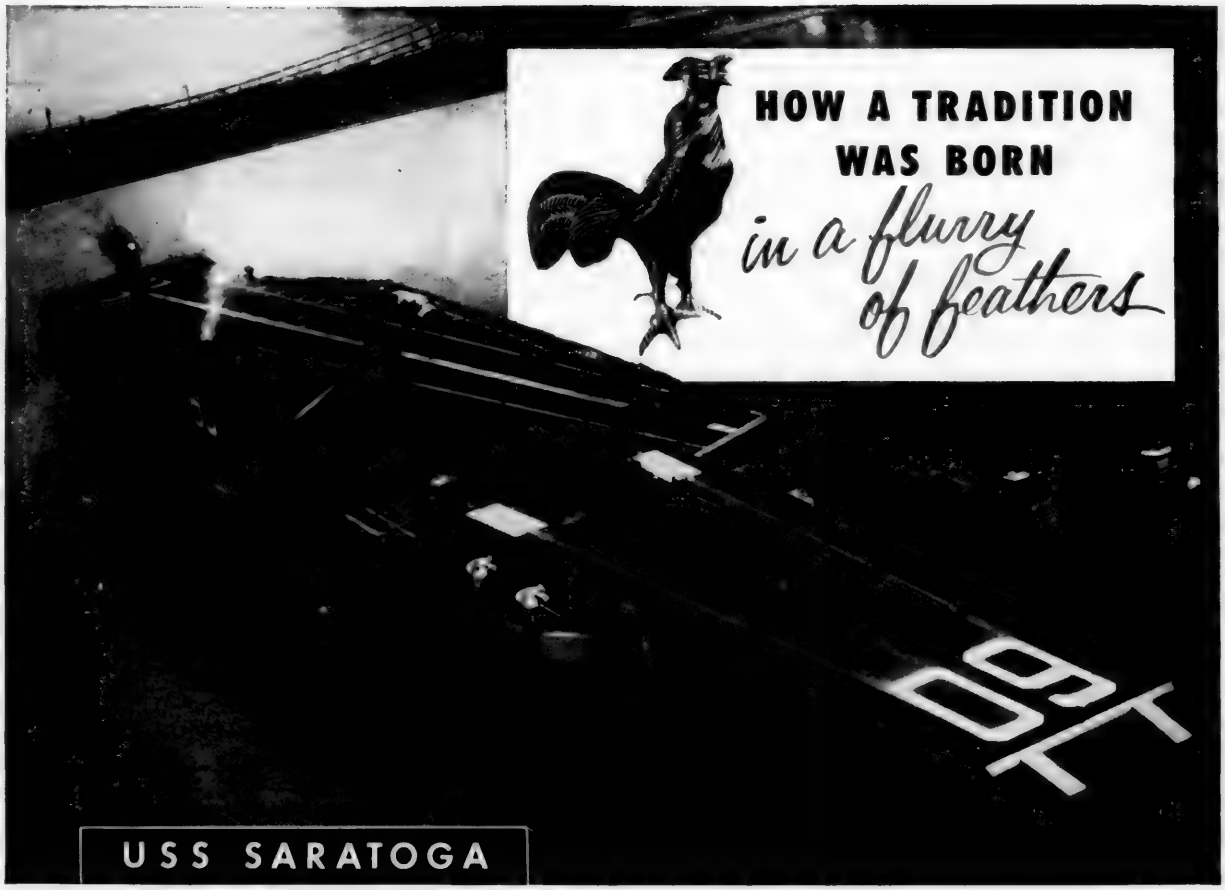
A feature of the pipe is that standard lengths are 10 ft with 20- or 30-ft lengths available on order. The longer lengths cut the laying time normally required for installation. One 30-ft length will eliminate up to six joints.

The company is manufacturing the pipe in 2, 3, 4, 5, and 6-in. diameters. A line of standard fittings is also carried in stock.

Catalog information is available.

More information? Circle Item 62 on postcard, page 101.

(*Concluded on page* 134)



The symbol, and the spirit, of the fighting gamecock lives on with the commissioning of the powerful aircraft carrier, *USS Saratoga*.

The incident which gave birth to this 142 year old Navy tradition took place on the decks of the first *Saratoga* as she closed for action against four men-o'-war in 1812. In the opening minutes of the engagement an enemy ball landed on deck – crashing into a coop containing a gamecock brought aboard by a sailor.

With a flurry of feathers, the startled bird flew to the rail and, as if expressing his personal indignation, crowed lustily and defiantly. Taking this as an omen of good luck, the outnumbered and outgunned American ship entered the battle with new courage and completely won the day.

The Navy's newest aircraft carrier is the fourth ship to bear the name *Saratoga* and adopt its fighting symbol. As aboard its sister aircraft carriers, the USS Forrestal, USS Independence*, and USS Ranger*, Walworth Valves and Fittings are installed. We are proud of the many contributions that our products and engineering skills have made to these outstanding vessels.

Walworth products installed aboard these ships include Pressure-Seal Cast Steel Gate, Globe, and Angle Valves, Fabricated Cast Steel Manifold Valves, Cast Steel Y-Globe and Angle Valves, Bronze Gate, Globe, Angle, and Check Valves and thousands of Walworth pipe fittings including Walseal® Fittings, Flanges, and Unions.

*Now under construction.

WALWORTH

60 East 42nd Street, New York 17, New York

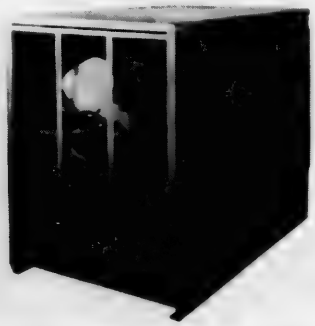
SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M&H M & H VALVE & FITTINGS CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. WALWORTH COMPANY OF CANADA, LTD.

(*Concluded from page* 132)

Cooling Tower Line Is Enlarged

A line of cooling towers in 15, 20, 25 (illustrated), 30, 40, and 50-ton sizes is introduced by Master-Bilt Refrigeration Mfg. Co., St. Louis, Mo.

The company will continue to manufacture smaller towers of 3, 5, 7½, and 10-ton capacities in order to



offer a selection for a variety of commercial and residential air conditioning applications.

A feature of the towers is a recessed fan venturi which provides a more compact and pleasing appearance.

Other features of the towers include removable redwood decking; propeller-type fan with 44-degree pitch, V-belt driven, and with the motor pivot-mounted for adjusting belt tension; exterior lubrication fittings; and adaptability to indoor or outdoor installation.

More information? Circle Item 63 on postcard, page 101.

Galvanized Scullery Sinks

Three models of hot dip galvanized, heavy duty scullery sinks are offered from stock by Just Mfg. Co., Franklin Park, Ill.

The three models with one, two, or three compartments are available with or without detachable drainboards for mounting left or right. The sinks are intended for use in schools, hospitals, restaurants, hotels, institutions and industrial plants.

All the sinks are formed and welded of 12 gage steel, hot dip galvanized after fabrication, and have a 1½-in., continuous roll rim at the front and ends with bull nose front corners and a 12-in. high back. Each sink includes angle legs with hold down clips, a soap dish, and the company's No. 15, 1½-in. C.P. brass drains with a rubber stopper, a chain, and a 1½ x 4-in. tailpiece. The compartments are 12 in. deep, measured from the top of the roll rim.

The sizes of three models available are: (overall dimensions) Model J-110-S 27 x 27 x 36 in. high from the floor to the top of the roll rim. Model J-210-S 51 x 27 x 36 in. high from the floor to the top of the roll rim. Model J-310-S 63 x 27 x 36 in. high from the floor to the top of the roll rim. Detachable drainboards available in 24- and 30-in. lengths.

More information? Circle Item 64 on postcard, page 101.

One-Inch Air Filter

A 1-in. thick, aluminum filter is announced by The George Evans Corp., Moline, Ill.

Made of aluminum, the filter pack has large openings on the inlet side progressing to smaller openings on the outlet side. The angled openings force air into a high turbulence and cause it to travel 3.5 times the filter depth from the inlet to the outlet side. The rough edges of the openings grip and hold dirt, permitting the pack to absorb lint without chocking the air stream.

Available in standard sizes, the filter can be cleaned by flushing it with ordinary tap water through a garden hose. It requires no high tension adhesive oil. A few ounces of the company's filter fluid which acts as both an adhesive and a detergent helps to wash out the filter when water is hosed on.

Engineering data, dust load curves, efficiency ratings, and pressure loss curves are published by the company.

More information? Circle Item 65 on postcard, page 101.

Paint for Hot Surfaces

A heat resistant paint for use on surfaces subjected to temperatures up to 600 deg F is announced by Speco, Inc., Cleveland, Ohio.

Known as Heat-Rem QD black, it dries in air in less than two hours. The paint resists extreme temperature variations, smoke, moisture, fumes, and mild industrial acids and alkalis. It is recommended for protecting steam lines, vats, separators, exhaust manifolds, stacks, tanks, ovens, and heat lines.

Applied by either brush or spray, the paint covers approximately 500 sq ft per gallon. It is available in quart and gallon cans, 5-gal pails, and 30- and 55-gal drums.

More information? Circle Item 66 on postcard, page 101.

This internationally-known research institute uses 1900 Glasfloss Fiber Glass Air Filters every three months to prevent dust build-up in electrostatic precipitators. Perfect atmosphere is needed to assure proper results in the many phases of research tests.

Glasfloss Air Filters help control atmosphere, lower air conditioning costs at world-famous research institute

More than 1900 Pittsburgh Glasfloss Air Filters are used every three months in the air conditioning system at this famous eastern research center to prevent dust build-up on electrostatic precipitators.

"Pittsburgh Glasfloss Filters help catch dust, prevent over-loading the electrostatic precipitators, lower maintenance costs through reduction of the number of times necessary for cleaning or flushing, and lessen the power load," reports the institute's director of engineering.

"Perfect air conditioning is a must at the institute, since we are devoted to long-range research of the effects of industrial techniques upon human welfare. We must control the atmosphere in order not to interfere with results of study on such subjects as air pollution, public health, sanitation and alleviation of industrial hazards. The fact that Pittsburgh Glasfloss Air Filters are constantly used in our air conditioning system speaks for itself."

GLASFLOSS FILTERS CAN GIVE YOU TOP SERVICE, TOO!

Pittsburgh Glasfloss Air Filters are made from fine, soft fiber glass which provides a greater, more efficient dust-collecting area, yet does not interrupt the flow of air. Glasfloss Filters are soft and easy to handle; this fiber glass does not splinter or pierce the skin.

Get top results from your heating and air conditioning systems with Glasfloss Filters. Try them once, and you'll buy them always! For the name of your local Glasfloss Distributor, call your nearest sales office, or write *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

PITTSBURGH GLASFLOSS FILTERS ARE A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia and St. Louis

FIBER PG GLASS

PAINTS · GLASS · CHEMICALS · BRUSHES · PLASTICS

PITTSBURGH PLATE GLASS COMPANY

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Air Curtains Exposed Glass Areas

PROBLEM: Where large expanses of glass exist, such as in office buildings, classrooms, and so on, with a concentration of nearby occupants, it is important that the inside surface temperature of glass be raised to near room temperature if optimum comfort is to be achieved. Air curtaining of the exposed glass area with continuous strip type diffusers is a practical means to accomplish a vertical (upflow or downflow) air discharge at the perimeter to remove the heat in summer or chill in winter experienced by persons near such exposed surfaces.

SOLUTION: In the offices of the Insurance Company of North America, Syracuse, N. Y., Agitair Stripline slot diffusers were installed in the low window sills. In each window sill a continuous diffuser 3½ inches in width and 16 feet in length curtains the entire glass surface, with warm or cool air to meet the comfort demands.

RESULTS: During the summer, heat gains are neutralized at the source—the exterior glass. In the critical winter season, the formation of cold down drafts is precluded and infiltrated air is heated at its source—the window cracks. Comfortable relative humidities are maintained without incurring condensation on the glass. Radiant heat loss from the occupants to the glass surface is reduced to the vanishing point and the even distribution of air assure comfort to all in the zone of occupancy.

Cooler Saves Cut Flowers

PROBLEM: Arvida Orchids Nursery, South Miami, Florida, will require a special building for the preparation and storage of cut flowers. One room of the building for storage of packaged flowers is to be maintained at 30 deg F without humidity control. A second room, however, must be maintained at 40 to 42 deg and 95% relative humidity.

SOLUTION: Jack E. Mitchell, consulting engineer, specified two Drayer-Hanson product coolers to handle the first storage room. The second room was found to have a high latent gain during early periods of product storage, but it was determined that maintaining 95% relative humidity would be increasingly difficult as the actual product load was decreased. After calculating the volume of air required to absorb the room sensible heat load, it was determined that approximately 25 pounds of water per hour should be added to the room. Arranging a pneumatic step controller to give four stages of refrigeration compressor capacity control, Mr. Mitchell specified a room humidistat to control the effect of four atomizing spray nozzles connected to the water supply line.

RESULTS: When the job was completed, a test run over a period of one week with recording instruments in the room showed that conditions were maintained exactly as specified.

Auto Coolers Boost Sales 25%

PROBLEM: Morton Foods of Dallas, Texas, one of the largest distributors of potato chips and other packaged foods, found that summer sales were affected adversely by the fact that salesmen who drive two or three hundred miles a day found it necessary to go to hotels, take showers and change clothes in each town prior to making any calls.

SOLUTION: Automobile air conditioners produced by Frigikar Corp. were installed in all salesmens' cars and delivery truck cabs. About 50 company vehicles were so equipped.

RESULTS: N. A. Cadell, Morton's vice-president in charge of sales, reports, "Since last July, when we equipped our salesmen's cars with Frigiking air conditioning units, sales have increased at least 25%." Salesmen arrive at their destinations fresh and ready for work and make more calls each day. In addition they are more contented and more ambitious.

Opera House Thermostats Control Ventilation

PROBLEM: While the New York Metropolitan Opera House, like any auditorium of comparable size, rarely finds it necessary to heat the interior during a performance, the accumulated body heat of patrons, coupled with the heat introduced to the building before the show starts, sometimes results in excessive warmth and moisture, particularly on upper levels. A means was required for controlling ventilation during performances.

SOLUTION: A new electronic control system, product of Minneapolis Honeywell, was installed. An outside thermostat responds to weather conditions while six thermostats indoors control required air supply to the five levels of the auditorium. Each indoor thermostat was built to detect the extra heat given off by the addition of a handful of new patrons. The system is capable of completely changing the air in the auditorium once every six minutes.

RESULTS: Regardless of the size of the audience or the conditions of outside temperature, comfortable conditions are maintained in the Metropolitan Opera House.

THE ONLY Matched

COOLING TOWERS and CONDENSERS

The Halstead & Mitchell Cooling Towers you select are *matched* by design to work with the famous Halstead & Mitchell water-cooled Condensers. You need no longer buy a high-efficiency cooling tower to work with a low-efficiency condenser (or *vice-versa*) . . . a long-life cooling tower to work with a short-life condenser (or *vice-versa*).

Remember that every cooling tower you sell is planned to work with a water-cooled condenser—then you'll see why America's leading manufacturers of air-conditioning and refrigeration equipment have swung to Halstead & Mitchell for their original equipment needs in both these components.

With cleanability you'll sell more. Why sell less?

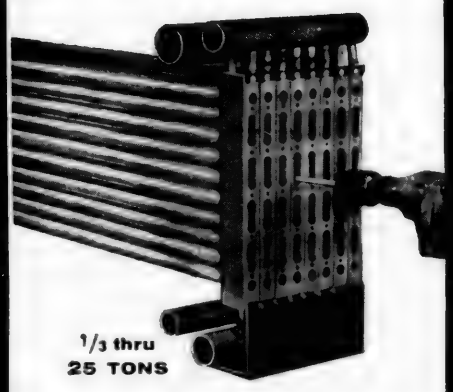
20-Year Guarantee!

on the wetted deck surface against rotting or fungus attack

Only Halstead & Mitchell pressure-creosoting can provide a *guarantee* against immediate attack by fungus and marine parasites . . . or chemical deterioration from acids in water.

Added to this H&M exclusive are other major advantages. There's ultra-high efficiency in the gravity-type water distributing pan which eliminates extra pumping head required on spray type towers . . . and cuts down on water losses due to "atomizing" of water. And there's extra-long life in stainless steel fans . . . and sheet steel cabinets hydraulically painted with vinsynite, vinyl zinc and chlorinated rubber.

2 thru 120 TONS



1/3 thru 25 TONS

Lifetime Cleanability

The *mechanical* cleaning of H&M double-tube, counter-flow condensers means the simplest, least dangerous method of restoring new unit efficiency. Whether removing a heavy coating of sludge and scale, or a thin insulating film on the inner walls of the copper tubing, the mechanical cleaning tool restores heat transfer efficiency in a matter of minutes. The result is lowered discharge pressures . . . more heat carried off by cooling water . . . lower bills. *Only* the impurities are removed . . . the thickness of the copper wall remains intact, and the condenser gives extra years of peak service.

At Leading Heating and Refrigeration Wholesalers EVERYWHERE

Write for Detailed Specifications

Halstead & Mitchell

BESSEMER BUILDING • PITTSBURGH 22, PA.

BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

PERFORMANCE OF WATER HEATERS

The storage tank size of domestic water heaters should be based on the peak load delivery capacity of a two-hour period which occurs during laundering, but should not be less than 30 gallons, according to a Building Research Advisory Board 37-page report on the Performance Characteristics of Domestic Water Heating Equipment transmitted to the Federal Housing Administration.

The report is the result of a study performed under contract between the FHA and the National Academy of Sciences and for the first time bases the storage tank size on capacity to deliver the quantity of hot water needed for a heavy use period rather than on the number of bedrooms and baths in a home.

The report may be used by FHA in considering any revisions in applicable minimum property requirements.

The 19-man BRAB Special Advisory Committee which performed the study was appointed by the National Academy of Sciences and its members were considered as individually highly qualified experts on the various technical aspects of the problem. The committee chairman was Dean F. M. Dawson, College of Engineering, State University of Iowa, and the committee members were selected from government, universities, foundations, manufacturers and trade associations.

The study was divided into five topics, defined by BRAB and approved by FHA:

1. Establishment of criteria which will insure a reasonable service life (10 years was regarded as reasonable).
2. Data on hot water consumption and determine equipment capacities that must be provided for adequate service.
3. Study of and recommendations on safety devices that should be required and how they should be installed.
4. Clearances that should be provided between water heating equipment and adjacent construction to permit servicing and replacement.
5. Study of manufacturers' warranties and guarantees to home owners to determine if such agreements are acceptable and enforceable as a means of assuring a reasonable service life.

FHA and BRAB have granted permission to the Building Research Institute to reprint the report for general distribution.

Performance Characteristics of Domestic Water Heating Equipment. Paper-bound, 38 pages, to be available in summer of 1956 at $1.50 from Building Research Institute, 2101 Constitution Ave., Washington 25, D. C.

NDHA 1954 PROCEEDINGS

The various papers, committee reports and discussions that took place at the technical sessions of the National District Heating Association at its 1954 convention held at The Greenbrier Hotel, White Sulphur Springs, W. Va., are contained in the 1954 Proceeding of the National District Heating Association. Listed in this book are the members of the various committees and the reports as presented at the meeting.

1954 Proceedings of the National District Heating Association. Cloth bound, 6 x 9 inches, 175 pages. Published by the National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. Price $10.

• • •

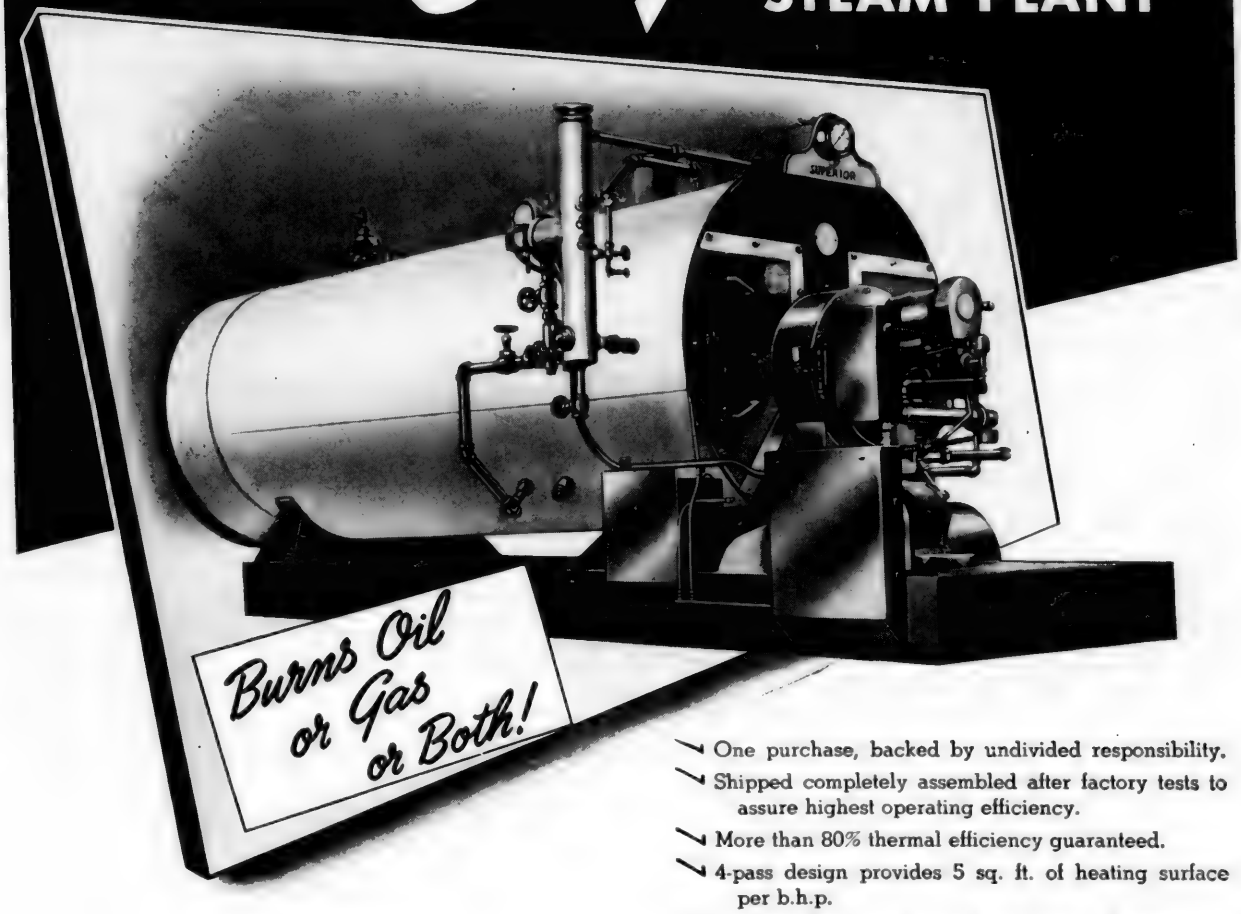
SAMPLING PROCEDURES—Chapter 6 of the Air Pollution Abatement Manual has been issued as a supplement to cover Sampling Procedures and Measuring Equipment. While Chapter 6 of the manual described the status of sampling procedures as of 1951, it was felt that a supplement to that chapter was necessary as new sampling and measuring techniques were developed since that date. Manufacturing Chemists' Association, Inc., 1625 Eye St., N.W., Washington 6, D. C. Price, 75 cents.

GAS APPLIANCE VENTING—A.G.A. Laboratories Research Report No. 1243. A Field Survey of Gas Appliance Venting Conditions, covers some of the second phase of PAR Plan Research Project DA-3-HA. Appraisal of Available Information on Venting Gas Appliances and Field Survey of Draft Conditions. A further analysis of field survey data, from which Report No. 1243 was prepared, is intended to yield additional valuable information at a later date. This report contains the first published information on the nature and magnitude of chimney or flue drafts and associated venting data as reported from domestic appliance installations in some 20 gas company areas throughout the United States. This information should provide a useful background for gas company engineers, appliance designers, and appliance installers confronted with venting problems. It also supplements the theories advanced in A.G.A. Laboratories Research Bulletin 68, Literature Review and Design Studies of Gas Appliance Venting Systems, with field data so that a firm basis is provided for other venting research activities now under way. Available for $1.50 from the American Gas Association, 420 Lexington Ave., New York, N. Y.

ELECTRIC HOUSE HEATING—As a guide for those interested in the design of electric heating installations, the National Electrical Manufacturers Association has issued a Manual for Electric House Heating. It contains information on the insulation of residences, a method of computing heat losses and thus the kilowatt heating capacity needs for the home, and a method of estimating the annual kilowatt-hour consumption. National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y. Price, 25 cents.

MEASURING SMOKE—The Bureau of Mines, United States Department of the Interior, has issued Report of Investigations 5162, entitled "A Comparison of the Smokescope and The Ringelmann Chart" by L. R. Burdick. The smokescope is a recent instrument for determining the density of smoke by shade comparison and the report is devoted largely to an investigation on the accuracy and convenience of the instrument. Available from the Bureau of Mines.

HERE'S YOUR *Complete* STEAM PLANT



- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.

For complete details, write for catalog 819

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR STEAM GENERATORS

DEGREE-DAYS FOR JUNE, 1956

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

AIR CONDITIONING, HEATING AND VENTILATING's 28th Year of Publication of Monthly Degree-Day Data

City	June			Season to June 30, incl.*		
	1956	1955	Normal	1955-56	1954-55	Normal
Abilene, Texas (A)	0	0	0	2585	2269	2707
Albany, New York (A)	40	41	50	7383	6518	6938
Albuquerque, New Mexico (A)	0	5	0	3855	4249	4389
Alpena, Michigan (C)	140	93	135	8095	7383	7938
Anaconda, Montana (C)	(a)	245	251**	(a)	8427	8261**
Asheville, North Carolina (C)	38	46	5	4246	4109	4072
Atlanta, Georgia (A)	6	0	0	2882	2751	2826
Atlantic City, New Jersey (C)	32	40	24	5067	4674	4741
Augusta, Georgia (A)	0	0	0	2653	2537	2138
Baltimore, Maryland (C)	4	14	0	4448	4046	4203
Billings, Montana (A)	16	115	119	7541	6905	7078
Binghamton, New York (C)	34	49	48	6864	6193	6520
Birmingham, Alabama (A)	7	0	0	2866	2686	2788
Bismarck, North Dakota (A)	13	119	116	9973	8184	8967
Block Island, Rhode Island (A)	104	111	96	6185	5553	5816
Boise, Idaho (A)	92	69	92	5848	6535	5890
Boston, Massachusetts (A)	54	73	42	6150	5468	5784
Bozeman, Montana (C)	(a)	256	230**	(a)	8427	8425**
Buffalo, New York (A)	71	37	72	6956	6187	6792
Burlington, Iowa (A)	21	(a)	34	6385	(a)	6101
Burlington, Vermont (A)	66	44	72	8175	7416	7799
Butte, Montana (C)	(a)	239	236**	(a)	8821	8162**
Cairo, Illinois (C)	6	9	0	3919	3542	3756
Charleston, South Carolina (C)	0	0	0	1886	1822	1769
Charlotte, North Carolina (A)	2	1	0	3257	3082	3205
Chattanooga, Tennessee (A)	17	1	0	3489	3277	3384
Cheyenne, Wyoming (A)	21	224	173	7176	7163	7490
Chicago, Illinois (C)	49	58	59**	5986	5454	6077**
Cincinnati, Ohio (C)	24	14	0	4592	4119	4532
Cleveland, Ohio (A)	69	35	46	6193	5414	5996
Columbia, Missouri (A)	15	29	14	5180	4550	5107
Columbia, South Carolina (A)	0	0	0	2708	2605	2284
Columbus, Ohio (C)	42	21	22	5551	4886	5277
Concord, New Hampshire (A)	81	89	82	7875	7000	7544
Concordia, Kansas (C)	5	36	20	5793	4931	5323
Dallas, Texas (A)	0	0	0	2328	2146	2272
Dayton, Ohio (A)	41	37	39	5877	5248	5591
Deer Lodge, Montana (C)	(a)	263	235**	(a)	8715	8582**
Denver, Colorado (A)	0	105	65	5745	5863	6116
Des Moines, Iowa (A)	11	44	45	6896	6006	6429
Detroit, Michigan (A)	61	27	60	6558	5820	6396
Devils Lake, North Dakota (C)	31	119	137	11,030	9225	9832
Dodge City, Kansas (A)	0	29	15	5166	4615	5058
Dubuque, Iowa (A)	32	67	76	7539	6827	7235
Duluth, Minnesota (C)	200	151	200	10,023	9158	9417
Elkins, West Virginia (A)	84	130	53	6129	5805	5733
El Paso, Texas (A)	0	0	0	2244	2523	2641
Ely, Nevada (A)	146	219	200	7446	8235	7377
Escanaba, Michigan (C)	125	100	166	8538	7750	8500
Evansville, Indiana (A)	26	29	6	4753	4293	4360
Fort Smith, Arkansas (A)	13	75	101	10,201	8713	9208
Fort Wayne, Indiana (A)	44	42	53	6386	5694	6270
Fort Worth, Texas (A)	0	0	0	2391	2193	2361
Fresno, California (A)	4	5	0	2586	3044	2532
Galveston, Texas (C)	0	0	0	1019	990	1211
Grand Junction, Colorado (A)	0	42	23	5089	6187	5796
Grand Rapids, Michigan (A)	62	44	79	7092	6353	7027
Green Bay, Wisconsin (A)	82	64	107	8515	7722	8169
Greensboro, North Carolina (A)	22	10	0	4132	3795	3810
Greenville, South Carolina (A)	6	0	0	3251	3107	3060
Harrisburg, Pennsylvania (A)	19	29	14	5560	5048	5258
Hartford, Connecticut (A)	36	70	31	6543	5853	6125
Hatteras, North Carolina (C)	0	0	0	2846	2523	2392
Havre, Montana (C)	55	120	125	9164	7763	8155
Helena, Montana (A)	113	197	197	8585	8452	8202
Houston, Texas (C)	0	0	0	1152	1134	1276
Huron, South Dakota (A)	10	71	80	9148	7319	7876
Indianapolis, Indiana (A)	42	51	30	5810	5270	5611
Jackson, Mississippi (A)	0	0	0	2432	2233	2202
Kansas City, Missouri (A)	5	17	8	5027	4347	4888
Knoxville, Tennessee (A)	23	9	0	3773	3530	3590
La Crosse, Wisconsin (A)	21	47	74	8139	7086	7619
Lander, Wyoming (A)	39	174	163	7867	7720	8273

(a) Data not available.

*Heating season cumulative, from Sept. 1.

**Same normal figures as previously listed by HEATING AND VENTILATING since new figures are not available. All other normal figures in this table are based on a 30-year period covering 1921 to 1950, inclusive, recently compiled and published by the U. S. Weather Bureau.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company. Tacoma figures through the courtesy of the Tacoma News Tribune.

[Table concluded on page 142]

IN THE
HARTFORD STATLER

kno·draft
"ROUNDS" AND "SQUARES"

Engineers: Jaros, Baum and Bolles
Mechanical Contractors: Alvord and Swift

Conditioned air is delivered to all offices and public rooms of the new, modern Statler Hotel in Hartford, Connecticut, through Kno-Draft Adjustable Air Diffusers. Both round and square units are used—and a few of the new slot-type Kno-Drafts (not shown).

Primary reason for selection of Kno-Draft was the greater comfort assured by *draftless* air movement, uniform temperature, and the easy and accurate control of both air volume and flow pattern.

And notice how neatly the Kno-Draft squares fit into acoustical ceilings and how—square or round—the handsome Kno-Draft units blend unobtrusively with the architectural scheme of things.

For complete specifications, engineering and installation information on Kno-Draft round, square and slot-type diffusers, simply write on your letterhead to Connor Engineering Corporation, Dept. J-86, Danbury, Conn.

CONNOR
ENGINEERING
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kno·draft®
adjustable air diffusers

Degree-Days for June, 1956 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 28th Year of Publication of Monthly Degree-Day Data

City	June			Season to June 30, incl.*		
	1956	1955	Normal	1955-56	1954-55	Normal
Lewiston, Maine (O)	106	87	45	7607	7060	7707
Lincoln, Nebraska (C)	7	42	32	6280	5471	5858
Little Rock, Arkansas (A)	0	0	0	3117	2846	2982
Livingston, Montana (C)	(a)	185	142**	(a)	7448	7185**
Los Angeles, California (C)	0	14	19	1511	1264	1451
Louisville, Kentucky (A)	30	20	5	4537	4168	4439
Lynchburg, Virginia (A)	37	24	5	4466	4131	4153
Macon, Georgia (A)	1	0	0	2261	2158	2049
Madison, Wisconsin (C)	25	66	79	7416	6796	7260
Marquette, Michigan (C)	159	125	189	8470	7770	8373
Memphis, Tennessee (A)	1	0	0	3256	3028	3137
Meridian, Mississippi (A)	5	0	0	2450	2371	2333
Milwaukee, Wisconsin (A)	67	82	109	7236	6572	7153
Minneapolis, Minnesota (A)	12	41	80	8570	7450	7828
Moline, Illinois (A)	26	44	45	6609	5990	6356
Montgomery, Alabama (A)	0	0	0	2280	2218	2137
Nantucket, Massachusetts (A)	(a)	(a)	139	(a)	(a)	6046
Nashville, Tennessee (A)	18	6	0	3753	3525	3513
New Haven, Connecticut (A)	39	53	52	6225	5631	6008
New Orleans, Louisiana (C)	0	0	0	1171	1116	1175
New York, New York (C)	20	41	18	5340	4865	5050
Newark, New Jersey (A)	19	34	11	5452	4898	5252
Norfolk, Virginia (A)	2	7	0	3700	3424	3454
North Platte, Nebraska (A)	5	108	59	7171	6578	6529
Oak Ridge, Tennessee (C)	26	22	(a)	3882	3828	(a)
Oakland, California (A)	112	183	119	3257	3300	3002
Oklahoma City, Oklahoma (A)	0	15	0	3912	3402	3519
Omaha, Nebraska (A)	7	40	32	6557	5602	6155
Parkersburg, West Virginia (C)	(a)	34	13	(a)	4645	4750
Peoria, Illinois (A)	26	42	41	6103	5551	6076
Philadelphia, Pennsylvania (C)	7	25	0	4878	4379	4523
Phoenix, Arizona (A)	0	0	0	1318	1436	1492
Pittsburgh, Pennsylvania (C)	44	37	13	5323	4754	5048
Pocatello, Idaho (A)	92	115	91	8045	7209	6905
Portland, Maine (A)	141	124	117	7996	7111	7610
Portland, Oregon (C)	135	127	70	4453	4488	4116
Providence, Rhode Island (A)	52	87	58	6407	5720	6099
Pueblo, Colorado (A)	0	40	27	5506	5336	5709
Raleigh, North Carolina (A)	9	3	0	3751	3392	3075
Rapid City, South Dakota (A)	0	140	148	7604	6795	7479
Reading, Pennsylvania (C)	13	24	11	5323	4797	5055
Red Bluff, California (A)	0	4	0	2658	3027	2546
Reno, Nevada (A)	123	124	165	6044	6537	5948
Richmond, Virginia (A)	10	12	0	4223	3884	3955
Rochester, New York (A)	72	35	54	7259	6387	6820
Roswell, New Mexico (A)	0	2	0	3436	3399	3424
Sacramento, California (C)	6	19	5	2427	2961	2600
St. Joseph, Missouri (A)	10	26	11	5790	5077	4703
St. Louis, Missouri (C)	9	22	7	4649	4129	4469
Salt Lake City, Utah (A)	35	85	81	5595	6474	5866
San Antonio, Texas (A)	0	0	0	1456	1227	1579
San Diego, California (A)	8	15	43	1517	1341	1556
Sandusky, Ohio (C)	59	21	41	6149	5323	5859
San Francisco, California (C)	187	239	180	2868	2988	2703
Sault Ste. Marie, Michigan (A)	171	108	224	9311	8473	9240
Savannah, Georgia (A)	0	0	0	2006	2020	1710
Scranton, Pennsylvania (A)	47	(a)	35	6812	(a)	6029
Seattle, Washington (C)	178	180	107	4861	4666	4344
Sheridan, Wyoming (A)	34	144	161	4974	7490	7835
Shreveport, Louisiana (A)	0	0	0	2190	2042	2117
Sioux City, Iowa (A)	9	46	54	7416	6283	6987
Spokane, Washington (A)	191	129	146	7185	7146	6807
Springfield, Illinois (A)	23	35	14	5766	5105	5225
Springfield, Missouri (A)	16	38	16	4819	4283	4685
Syracuse, New York (A)	49	22	37	7221	6376	6491
Tacoma, Washington (C)	155	162	143	4938	4771	4738
Toledo, Ohio (A)	55	34	60	6739	5774	6382
Topeka, Kansas (C)	6	21	13	5255	4587	4919
Trenton, New Jersey (C)	16	36	11	5340	4855	5068
Tulsa, Oklahoma (A)	0	5	0	3765	3191	3584
Utica, New York (O)	53	31	0**	7470	6839	6796**
Valentine, Nebraska (A)	6	119	83	7907	6668	7054
Walla Walla, Washington (C)	71	36	38	5406	5089	4848
Washington, D. C. (C)	13	15	0	4427	4062	4258
Wichita, Kansas (A)	4	20	7	4895	2223	4571
Williston, North Dakota (C)	26	129	138	9761	8302	8997
Winnemucca, Nevada (A)	201	126	111	6483	7314	6352
Yakima, Washington (A)	129	69	53	6712	6198	5838

For footnotes, see page 140.

There's **MORE** Cooling Surface in these deep-ribbed **MOTORS**

No Day is FRYDAY

with these Allis-Chalmers MOTORS

● Frying of insulation is impossible under normal conditions with the extra-large cooling surface of Allis-Chalmers rib-type TEFC motors. The result—you expect and get longer motor life.

The engineered partner of A-C motors is Allis-Chalmers control.

Get Complete Information

As a new machinery component or as replacement, specify Allis-Chalmers. Discuss your particular application with your nearby A-C distributor, A-C district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-4919

NEWS OF THE MONTH

TWO COMPANIES

sign agreement to transfer air conditioning division. Manufacturing plant and personnel to change hands.

An agreement transferring the air conditioning division of Union Asbestos & Rubber Company to National-U. S. Radiator Corporation has been signed by both companies.

In announcing the acquisition, Theodore B. Focke, president of National-U. S. Radiator Corporation, stated that the move was a further step in the direction of broadening that company's activities in the fields of heating and summer cooling.

Edwin E. Hokin, president of Union Asbestos & Rubber Company, said he felt the sale would be equally beneficial to both organizations.

• **PLANT IS TRANSFERRED.**—The principal acquisition in the transfer is a manufacturing plant located in Greenville, Ill. It was stated by spokesmen for both companies that the majority of all personnel connected with the operation of the division were being transferred to National-U. S. Radiator Corporation with no change in duties.

Union Asbestos & Rubber Company's air conditioning division has been a major supplier of air conditioning products to National-U. S. Radiator Corporation for several years. Mr. Hokin stated that the transfer of the air conditioning division is the result of a long term policy decision to concentrate Union Asbetsos & Rubber Company's activities on its older and more established divisions.

• **WILL USE SAME LABEL.**—National-U. S. Radiator Corporation plans to continue to market its air conditioning products under the Unarco label. Mr. Hokin pointed out, as they feel the name has gained acceptance in the industry, despite the relatively brief period in which Union Asbestos & Rubber Company was engaged in the air conditioning business.

APPLIED HEAT TRANSFER

will be subject of first national conference sponsored by ASME division. Papers are being solicited.

The first national conference on applied heat transfer will be held next August under the sponsorship of the heat transfer division and the Central Pennsylvania Section of the American Society of Mechanical Engineers with the cooperation of the College of Engineering and Architecture of the University of Pennsylvania.

• **PAPERS ARE SOUGHT.**—To be held at Pennsylvania State University, the theme of the conference will be applied heat transfer, and papers are being solicited which bear directly upon heat transfer applications. Particularly sought are papers dealing with the design, construction, and use of heat exchangers, economic and practical problems associated with insulation, methods of instrumentation and tests, and the results of research which may be applied in industrial practice.

• **TO HONOR PROFESSOR.**—A special feature of the conference will be a dinner and ceremonies honoring Professor William H. McAdams of Massachusetts Institute of Technology on the occasion of his retiring from teaching. A special effort is being made to invite former students of Professor McAdams to be present at the ceremonies which the sponsors are arranging to honor his contributions to the field of heat transmission.

The program is being arranged under the general direction of Professor G. M. Dusinberre, a member of the heat transfer division's executive committee, the Central Pennsylvania Section of the ASME, and of the faculty of the College of Engineering of Pennsylvania State University.

Professor Dusinberre has announced that the deadline for the submission of papers for the conference is January 1, 1957. The papers must be submitted to Papers Committee Chairman H. A. Johnson of the Department of Mechanical Engineering, University of California in Berkeley.

• **EQUIPMENT EXHIBIT.**—In connection with the conference there will be an exhibit of equipment and apparatus useful in industrial heat transfer. Manufacturers of equipment for the measurement, recording, control, and production of heat transfer and thermal processes are invited to exhibit their wares. The exhibits will be under the supervision of A. H. Zerban of Hamilton-Standard Co., Windsor Locks, Conn.

C. M. WOOLLEY

dies in California at 92. Former chairman of American-Standard pioneered central heating systems.

Clarence Mott Woolley, former chairman of American Radiator and Standard Sanitary Corporation, died last month in Banning, Calif., at the age of 92.

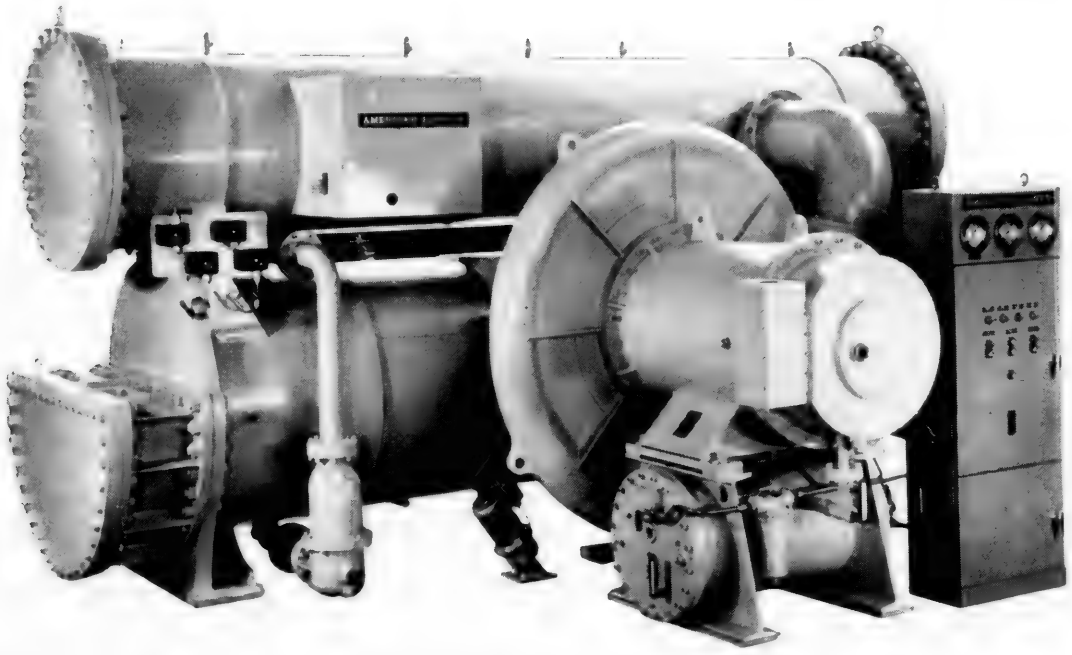
• **ORGANIZER.**—One of the organizers of the American Radiator Company, he served as its president from 1902 to 1924, and as board chairman from the latter year until 1938, when he retired. At that time he retained a directorship in American Radiator and Standard Sanitary Corporation, by which name the company had become known in 1929 as the result of mergers.

Mr. Woolley was born in Detroit. In 1887 he assisted in organizing the Michigan Radiator and Iron Company. He moved to Chicago in 1892, the year in which American Radiator was formed. He had resided in Banning, Calif., and Palm Springs for more than ten years before his death.

For a long period, Mr. Woolley served as president and trustee of the John B. Pierce Foundation, which was established by a former business associate for research in the field of heating, ventilating, and sanitation. One of the foundation's plans for prefabricated homes was adopted by the Government.

(*News continued on page* 146)

AMERICAN BLOWER
AIR CONDITIONING



Tonrac* maintains chilled-water temperature–regardless of load!

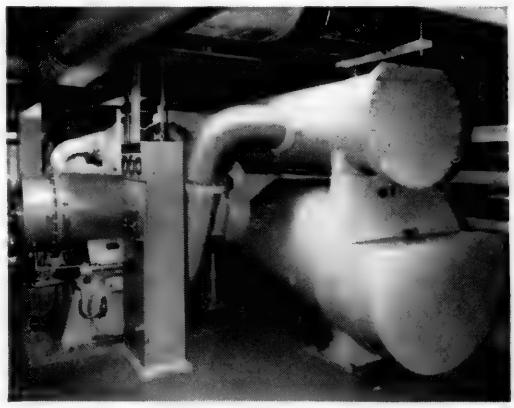
American Blower's single-stage hermetic centrifugal refrigerating machine — Tonrac — automatically adjusts refrigerating capacity to cooling needs. "Tracking the load," Tonrac operates efficiently from full load to no load.

Variable inlet guide vanes regulate the quantity, velocity and direction of the refrigerant gas flow to the compressor in direct response to the amount of cooling load.

Single-stage design eliminates two or more compression stages with their inherent cross-over losses. This, plus improved diffusion in the volute casing, insures optimum performance, quieter operation.

What's more, Tonrac's *single-level* construction requires no built-up bases. A compact, self-contained unit ready for installation, Tonrac may be located wherever the floor will support the charged weight of the system — even on the roof.

For further information on Tonrac, contact our nearest branch office, or write us direct. American Blower offers a complete product-line — from Packaged Air Conditioners, to Multi-Zone Units and Central Station Air Conditioners — to meet *all* your air conditioning requirements! American Blower Corporation, Detroit 32, Michigan. In Canada: Canadian Sirocco Company, Ltd., Windsor, Ontario.



Compactly designed, accessible — Tonrac operates on constant-speed 3600 rpm motor. Push-button control (left foreground) initiates quiet, efficient, automatic operation.

*TRADEMARK

AMERICAN BLOWER

Division of AMERICAN-Standard

Air conditioning equipment for every business

(*News continued from page 144*)

STRONGER MEASURES

are recommended to control air pollution in Chicago. Changes to air pollution code are proposed.

Stronger measures to control air pollution in Chicago were recommended recently to Mayor Richard J. Daley.

The recommendations for changes in the city's air pollution code were presented by Thomas H. Carey, director of the Department of Air Pollution Control, at a meeting in the mayor's office.

"The proposals were designed to effect a noticeable reduction in air pollution in an orderly, progressive, and practical manner," Mr. Carey explained.

• **PROPOSED CHANGES.**—Recommended changes in the air pollution code include: Formation of an air pollution policy and appeal board; enforcement based on performance rather than specification; increase in fines for repeat offenders; licensing of personnel dealing with plants and processes tending to emit pollutants; and the extension of control to additional air pollution sources.

The recommendations were made to the Department of Air Pollution Control by the Midwestern Air Pollution Prevention Association, which was asked to suggest measures to strengthen the city's air pollution abatement laws.

The code revisions were formulated by scientists at the Armour Research Foundation of the Illinois Institute of Technology and by an engineering committee representing industry and commerce.

"The report stresses the need for better housekeeping by the entire community and for a more rational coordination of control of all sources of air pollution," pointed out Dr. Haldon A. Leedy, director of Armour Research Foundation and president of the MAPPA.

"The recommendations suggest reliance to a greater degree on performance," Dr. Leedy said, "and to a lesser degree on mandatory specifications of construction, operation, and maintenance of equipment and plants, thus placing responsibility on the plants and operators."

PETROLEUM PRODUCTS

are being extracted from a mineral other than crude oil. Ore will be piped 71 miles in slurry form.

Fuel gas, high octane gasoline, and electrolytic coke will be extracted from a mineral named Gilsonite by American Gilsonite Co., Salt Lake City, Utah.

Facilities for converting the ore into petroleum products are being constructed by the company in a $16,000,000 project that includes new wet mining techniques, a 71-mile pipeline for transporting the ore, and a new refinery.

The raw material is a black, solid hydrocarbon that is believed to have been formed from petroleum or crude oil millions of years ago.

Under the trade name Gilsulate, the mineral is used in the piping and heating fields as an insulation for hot underground pipes.

Though technically an asphaltite but different from asphalt, it occurs in nearly vertical fissures that vary in depth from 100 to 1500 ft and in width from a few inches to 22 ft.

• **PIPED IN SLURRY.**—The ore will be piped in slurry form from Bonanza, Utah, where it is mined, to a new processing plant the company is constructing near Grand Junction, Colo.

Using a delayed coker, a fractionator, and a catalytic reformer, the plant will convert 50% by weight, of the solid, brittle ore into green coke, 35% into gasoline, and 15% into a 1400-Btu gas which will be used as plant fuel.

Credit for the discovery of the substance is generally attributed to T. H. Wigglesworth, a surveyor for the Denver & Rio Grande Railway, who first reported it in 1883. In 1884, Samuel H. Gilson, whose name was applied to the ore by local people, devoted his efforts to finding a market for it.

In 1950, the mineral was developed for use as an insulation for hot underground pipes.

INFORMATION LETTER

lists fundamental safety standards for installing gas piping. Intended to supplement ASA standards.

Fundamental standards of safety to be observed when installing gas piping are outlined in an information letter, No. 70, prepared by the Industrial Gas Practices Committee of the American Gas Association.

The letter is entitled "AGA Recommended Good Practice Requirements for Installation of Consumer-Owned Gas Piping on Industrial and Commercial Premises." It lists information not covered by American Standard Installation and Gas Appliances in Buildings (ASA Z21.30, 1954).

• **TO SERVE AS SUPPLEMENT.**— Intended to ultimately serve as a standard, the letter contains basic standards which supplement the Code for Pressure Piping (ASA B31.1-1955) and the Standard for Gas Transmission and Distribution Piping Systems (ASA b31.1.8-1955).

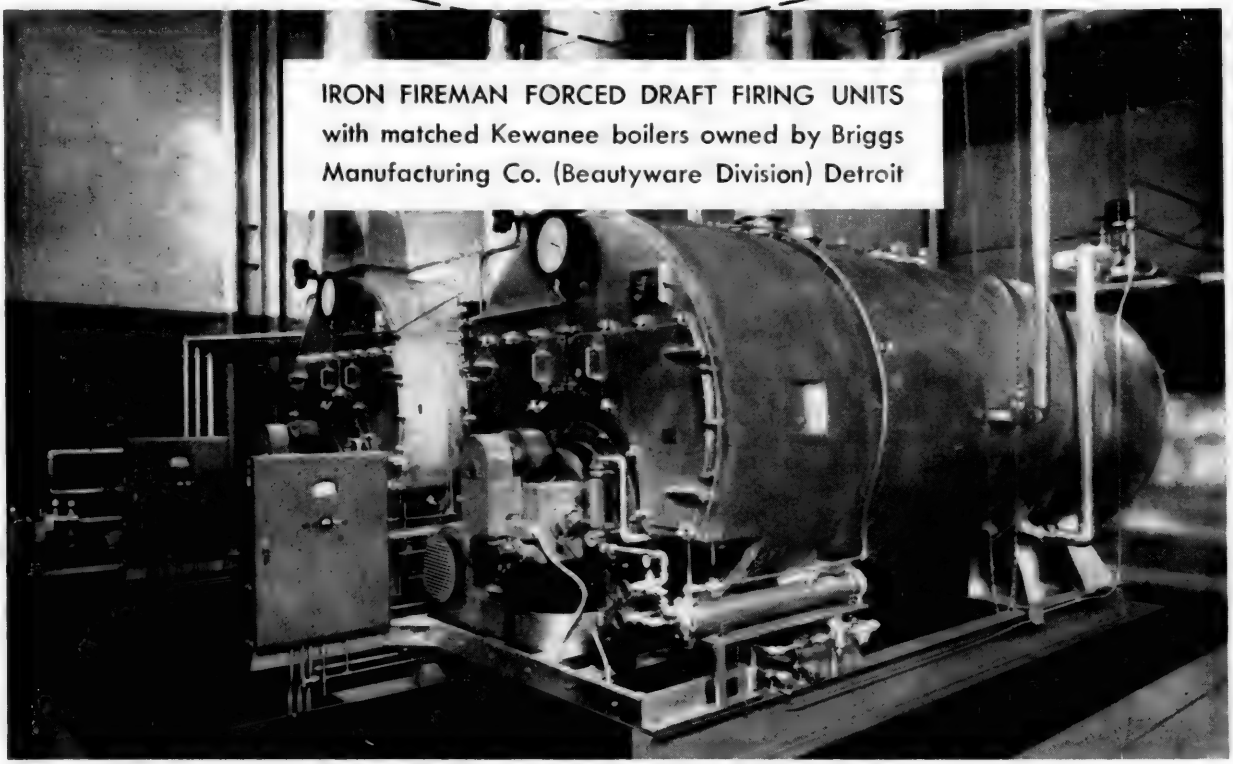
The latter standards govern the installation of consumer-owned gas piping, both in and between buildings, extending from the point of delivery to the inlet connections on gas-burning equipment. They are intended to cover piping systems for industrial installations at any pressure and for all other non-residential installations at operating pressures in excess of ½ psig.

• **INCLUDES DATA.**—Tables are included in the letter that compare the resistance of bends, fittings, and valves to that of equivalent lengths of straight pipe. Pipe sizing tables for pressures from less than 1 psi to 50 psi are also included.

The information letter (No. 70) can be obtained from the industrial gas departments of local gas companies or directly from the American Gas Association at 420 Lexington Avenue, New York 17, New York.

(*News continued on page 148*)

What a truly modern heating plant looks like


IRON FIREMAN FORCED DRAFT FIRING UNITS
with matched Kewanee boilers owned by Briggs
Manufacturing Co. (Beautyware Division) Detroit

Jahr-Anderson Associates, Architect-Engineer, Dearborn, Mich. W. J. Rewoldt Co., Mechanical Contractors, Detroit. Iron Fireman equipment installed by Comb & Groves, Detroit.

COMPLETE FIRING SYSTEM IN ONE PACKAGE

Every essential component is built into this Iron Fireman forced draft firing system, including burner, control panel, forced draft air supply and fuel system. Complete unit is factory assembled, wired, and tested.

FIRES ALL TYPES OF BOILERS

Firing unit can be applied to any type of boiler with great advantages in installation costs and operating efficiency. Complete boiler-burner unit is also available as pictured above, with matched Scotch type boiler. Installation requires little more than service connections. No high stack needed.

ONE CONTRACT—ONE RESPONSIBILITY

Installation costs are greatly reduced. No separate contracts for control system, electrical wiring, oil heaters, or burner setting.

FOR GAS OR OIL, OR OIL-GAS COMBINATION

Takes any type of high or low pressure gas, or any grade of oil from No. 2 to No. 6. Oil-gas model can be switched from one fuel to another at a moment's notice without loss of firing efficiency.

The smart way to modernize

Unlike typical conversion burners, the Iron Fireman forced draft firing system is completely assembled at the factory, and mounted on a permanent base for fast and accurate application to your present boiler. It is a completely engineered unit, leaving no intricate wiring or piping for completion on the job.

Where a complete boiler-burner unit is required, the Iron Fireman forced draft firing system is supplied as an integral part of a matched Titusville or Kewanee boiler, as in the Briggs plant pictured above. The rated capacity of these boiler-burner units (for either high or low pressure steam) allows an ample margin which can easily carry overloads of 50% or more. This permits a comfortable "cruising speed" that assures long life and low maintenance costs.

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(*News continued from page* 146)

TESTING LABORATORY

will be erected by IBR in Urbana, Ill. Tests will supplement manufacturers'. Temporary director is named.

Construction of a specialized testing laboratory for the Institute of Boiler and Radiator Mfrs. is expected to be underway shortly at Urbana, Ill.

Plans were announced recently by Robert E. Ferry, general manager of the Institute.

Purpose of the laboratory, Mr. Ferry said, will be to provide check tests on baseboards and finned-tube radiators where the Institute's ratings are involved, supplementing original tests conducted by the individual producers.

The property and building have been selected and designed so that expansion will be possible when the Institute decides to test other types of heating and cooling equipment, Mr. Ferry pointed out.

• **TEMPORARY DIRECTOR.**—Warren S. Harris, associate research professor of mechanical engineering who conducts the Institute's research program at the University of Illinois, will supervise the laboratory until a permanent director is named. Professor Harris has supervised research work on residential heating and cooling in the Institute's research home at Urbana since 1940.

It was indicated that about five persons will be employed in the laboratory on a full-time basis.

"This laboratory will not be associated in any way with the University of Illinois as the IBR research program is," Mr. Ferry noted. "The lab will be owned and operated solely by IBR."

He said work would continue on the regular research program which Professor Harris supervises at the research home in cooperation with the University.

ABSORPTION MACHINES

will be used in the air conditioning system of new airport buildings. Will be powered by hot water.

New York International Airport's new Terminal City central air conditioning system will employ the world's largest installation of absorption refrigerating machines and will be one of the first in history to use the energy from hot water to produce cooling.

Charles V. Fenn, vice president of Carrier Corporation's machinery and systems division, said the contract for $401,370 awarded by The Port of New York Authority calls for five of the big machines with a total cooling capacity of 3500 tons. The firm of Seelye, Stevenson, Value and Knecht is the consulting engineer.

The order is part of a $60 million program to construct an international arrival building, two adjacent airline wing buildings, and individual terminal buildings capable of accommodating 140 aircraft at one time within a 655-acre landscaped area at the airport. At the same time, an order from Pan American World Airways for a sixth absorption machine of the same size to be used in air conditioning their new maintenance area at Idlewild was announced by the Carrier executive.

• **WATER AS REFRIGERANT.**—The automatic, push button absorption unit has no major moving parts and uses plain water as a refrigerant.

The machines covered in the Port Authority contract will provide chilled water for the air conditioning of the major structures in the new airport development. The chilled water service will be distributed through underground pipes from a central powerhouse as in the case of other utilities.

Pipelines will extend nearly half a mile to supply some of the structures in the Terminal City oval. The main trunk line from the central station will be 2 ft in diameter, Mr. Fenn said.

• **POWER SUPPLY.**—The high temperature and pressure hot water employed to power the cooling machines will be the same as that used for winter heating. Employing it for air conditioning, too, equalizes the year-round load on the boilers, providing a better return on the initial investment.

Mr. Fenn described this as the second major cooling installation in history to operate on hot water, but predicted there would be many more in new structures obtaining such boiler facilities. He said that in many similar cases operating and installation economies would result.

Biggest building to be air conditioned using the new chilled water supply will be the International Arrival Building with its two adjacent Airline Wing Buildings. It is to be three stories tall in its highest section and will stretch for eleven city blocks. It is expected to be host to long distance air travelers in mid-1957.

INDOOR CLIMATE

is being studied for new Air Force Academy. Experimental rooms equipped with recording instruments.

A research program is being conducted on the site of the Air Force Academy at Colorado Springs, Colo., to help engineers, scientists, and military officials find an indoor climate in which cadets will learn most effectively.

Details of the experiment were disclosed by Air Force Secretary Donald A. Quarles following a tour of the Academy site and a review of preliminary findings by engineers of the Air Force Academy Construction Agency and Minneapolis-Honeywell Regulator Company, who are cooperating in the studies.

• **EXPERIMENTAL ROOMS.**—Two 13 by 18-ft dormitory rooms have been built as exact duplicates of the quarters which will house the Academy's 2600 cadets. The experimental rooms are the first structures to be erected on the 17,500-acre site 10 miles north of Colorado Springs.

The rooms are equipped with instruments which read and record air temperatures at six points, chart the effects of the sun, air movement, humidity, and other conditions that affect human comfort and efficiency. The rooms are also furnished with automatic temperature controls so

(*Continued on page* 150)

One of two new hangars for jet planes of the Strategic Air Command's 813th Air Division, Pinecastle Air Force Base, Orlando, Fla. Beth-Co-Weld Steel Pipe, used in sprinkler systems, was installed by Moore Pipe & Sprinkler Co., Jacksonville.

Air Force Hangar in Florida . . .

Hospital in Connecticut . . .

Both Use Beth-Co-Weld

Beth-Co-Weld Steel Pipe is used for plumbing and heating lines in new Fairfield State Hospital, Newtown, Conn. *Contractor:* Buckingham Routh Co., New Haven; *Jobber:* Parsons Bros., Inc., Bridgeport.

Whether it's for general-purpose piping, or for sprinkler systems, you'll find that Beth-Co-Weld is good, sound, easy-working steel pipe.

Beth-Co-Weld is easy to cut, thread and weld, and is a dependable performer as well, because it is made from a good grade of steel by the continuous-weld process.

Most jobbers stock Beth-Co-Weld Steel Pipe in all sizes from $\frac{1}{2}$ in. to 4 in., standard-weight, and from $\frac{1}{2}$ in. to 3 in., extra-strong weight, in 21-ft lengths, plus or minus 1 in., and in random lengths.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Bethlehem Pacific Coast Steel Corporation, *Export Distributor* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

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(Division of National-U.S. Radiator Corporation)

INDOOR CLIMATE

(*Continued from page* 148)

indoor conditions can be regulated and the effects of the changes recorded.

Data recorded by the instruments will be supplemented by reports from Air Force second lieutenants who are living in the completely furnished laboratory rooms and carrying out duties similar to those which Academy cadets will perform.

The project is under the supervision of Col. Albert E. Stoltz, director of the Air Force Academy Construction Agency which has the mission of constructing the modern service school.

• **PURPOSE OF RESEARCH.**—Disclosing details of the study, Col. Stoltz said, "It is recognized that human efficiency depends on human comfort. Because much of the cadet's actual learning will come from his after-classes studies, it is essential that conditions in the dormitory rooms be coordinated and designed to provide the most efficient learning climate possible.

"The problem is especially critical in this area," Col. Stoltz continued, "because of the intense daytime sunlight, cold nights, rapid outside temperature variations, and climatic changes.

"Before proceeding with construction of the buildings we must determine how they will be affected by these conditions."

Col. Stoltz pointed out that the project will also make possible the testing of room arrangements, furnishing, lighting, sound, and equipment—even doorknobs—before they are installed in the completed buildings.

Instruments used in the experiment include a radiation detecting device called a two-sphere radiometer which was developed by Honeywell research scientists to study the effect of sunlight on residential, school, office and factory heating, and air conditioning. Consisting of two dissimilar sensing elements, it measures and records the effect of sunlight on inside temperatures, shows what happens indoors when the sun goes down or is obscured by clouds, and measures the gain or loss of radiant heat due to sunlight, bright skies, or cold walls and windows.

RIVER FISH

stop Chicago newspaper's cooling system during unseasonable warm spell. Made pumps lose prime.

Air conditioning maintenance personnel detected something fishy in The Chicago Tribune's air conditioning system recently. They found it was smelt.

When unseasonable heat and humidity hit the Windy City, Tribune plant maintenance personel turned on the giant cooling system to counteract the 79-degree weather Although the system normally has a cooling capacity of 1700 tons, nothing happened.

• **WATER INTAKES CLOGGED.**—The men checked two huge intake pipes which draw water for the cooling sys-

(*Concluded on page* 152)

DOLLINGER

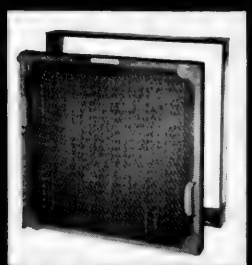
STAYNEW FILTERS FOR EVERY VENTILATING APPLICATION

STAYNEW AUTOMATIC AIR FILTERS

Designed for filtering large air volumes efficiently, these self-cleaning filters give you positive protection against oil entrainment in the air stream. This protection is provided by an exclusive Staynew feature—a second dry curtain providing a double filtering action. Ask for Bulletin 500.

VISCOUS PANEL FILTERS

Low cost, permanent, washable type for locations where highly efficient filtration is not required. Large dust-holding capacity with amazingly low resistance to air flow. Unsurpassed for ease of cleaning. Ask for Bulletin 700.



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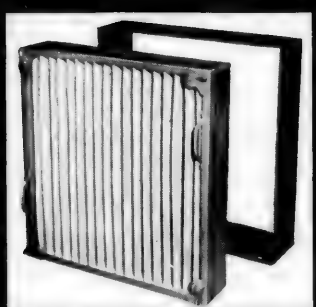
Highly efficient for heavy duty Ventilation work. Operates with any filtering medium that comes in sheet form and can be crimped. Preformed media can be inserted quickly and easily when required. Ask for Bulletin 600.



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Highly efficient—removes 90% of all air-borne dirt, including smoke, dust, pollen, oil mist. Ionizer and Collector in one unit. Available in single unit of 1200 and 1800 CFM; any capacity in multiple units. Ask for Bulletin 400.

ELECTRO-STAYNEW MIST COLLECTOR

Provides self-contained ventilating system for individual machine tools. Removes air contaminated with oil, smoke, grit, and chips and returns clean air to shop. Saves you hundreds of dollars in building maintenance expense and lost man-hours due to employee sickness. Ask for Bulletin 420.

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Whatever your filtering problem, wherever you are, there's a Dollinger representative ready to help you solve it with a *Staynew* filter—the *only* complete line of industrial and ventilating filters available.

Write today, and ask for catalogs describing the filters illustrated above. Dollinger Corporation, Dept. 15, Centre Park, Rochester 3, N. Y.

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ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

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VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS
AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

AVAILABLE FROM STOCK!

NEW

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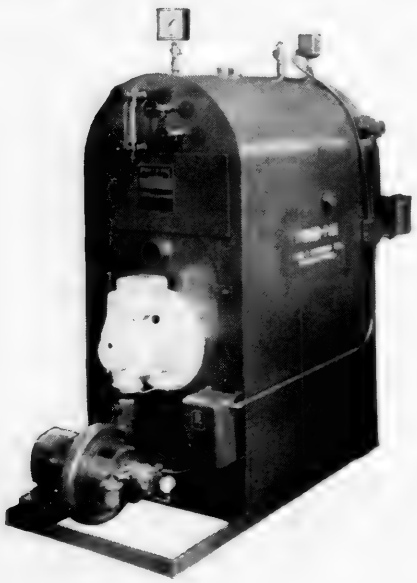
Packaged Automatic Boiler



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Ideal for low-pressure steam or hot-water heating loads up to 25 hp in motels, schools, stores, bakeries, garages, churches, florists, industrial loads and many other applications. Choice of oil or gas firing with rugged industrial type burners. Delivered ready for operation. Built and fully guaranteed by O&S, builders of *Powermaster* boilers. Available in 10, 15, 20 and 25 hp sizes. Can be supplied with coils for storage tank or instantaneous hot-water service.

Get more information now by sending for Bulletin 1233.

ORR & SEMBOWER, INC.

Reading, Pa.

builders of dependable boilers since 1885

RIVER FISH

(*Concluded from page* 150)

tem from the Chicago river. They found the openings plugged with smelt. Thousands of the tiny fish were plastered against the ½-in. wire screen protecting the 16-in. opening through which water is siphoned into the system from 14 ft below the river's surface.

The fish prevented water pumps from maintaining their prime, and the cooling system could not operate.

The situation improved a little on the following day although the temperature climbed to 81 degrees. The smelt run eased up a little, and building maintenance crews operated the system at one-quarter speed.

Tremendous quantities of river water are used in The Tribune's two main systems. In the steam jet system, water is employed to condense the spent steam. In the centrifugal system, it is used in the refrigerant condensers and is then returned to the river through an 18-in main.

ECONOMICS OF HOUSE-HEATING FUELS

(*Concluded from page* 108)

apartments and 24 3-room apartments on 8 floors, and floor warming is supplied in the living-room and hall of each apartment. An extra electric radiator is supplied for "topping up" and to provide a focal point to sit around (television sets are gradually displacing this social necessity). On the continent of Europe, where whole house warming by stoves or central heating is the rule, families commonly sit around a table in the evening, but not in Britain. Flames are more interesting than many television programs and for years a large proportion of electric heaters had some kind of flickering device to imitate flames.

The following assessment of weekly costs will be of interest. The figures have been converted to dollars at the present rate of exchange. To obtain a comparison in terms of family income they should be multiplied by about 2 or 3.

Service	*3-room apt.*	*2-room apt.*
Hot water	$0.66	$0.34
Floor-heating	0.90	0.74
Extra electric radiator	0.40	0.35
Cooking	0.27	0.20
Lighting, etc.	0.24	0.17
Total, per week	$2.47	$1.80

This is for a service which involves no trouble with ashes or fumes and exceedingly low maintenance. It is claimed that electric heating leads to much longer life of internal decoration and furnishings.

Moule's paper is followed by a paper by O. W. Humphreys who makes a comparative assessment of the costs of maintaining living quarters at a comfortable 65 deg. According to him, only oil seriously rivals electricity. But if he is right, there is going to be a much greater use of oil domestically in Britain than anyone so far has dared to forecast.

Ric·wiL *Serves*

620 Mile Pipeline

Here is REAL PROOF of Ric-wiL superior quality and performance... This recent installation of over 600 miles of pipeline represents a tremendous investment... and... a tremendous "vote of approval" for Ric-wiL systems.

Next time you specify piping... specify Ric-wiL and *know* you are getting the finest.

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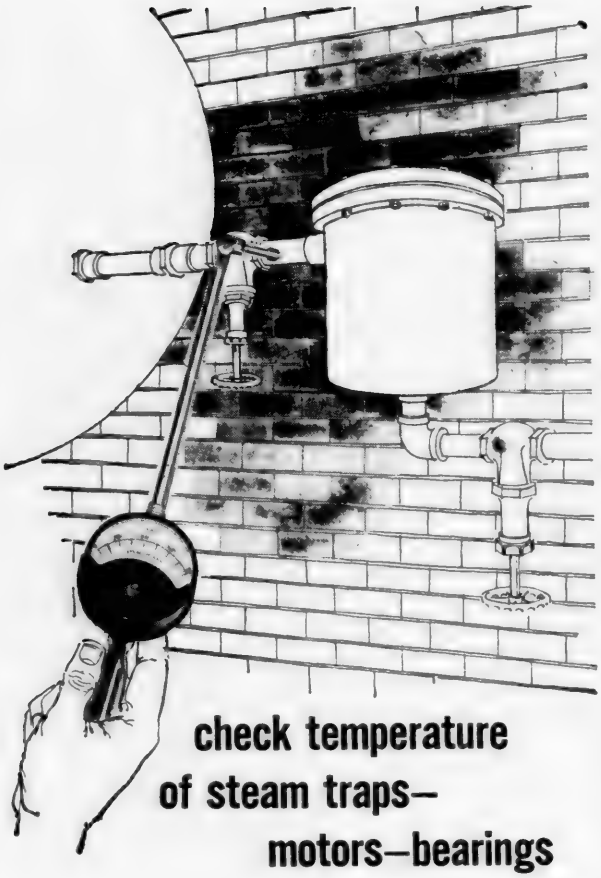
NEW Ric-wiL catalog is now available... write for your copy... today.

Quality Piping Systems...
... of Exceptionally High Thermal Efficiency

RIC-WIL INCORPORATED PREFABRICATED **INSULATED PIPING SYSTEMS**

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED



check temperature of steam traps— motors—bearings

. . . quickly and accurately with the Alnor Pyrocon, the portable contact pyrometer for taking surface temperatures. This handy, portable instrument can be your most useful maintenance and installation tool . . . it provides accurate temperature readings instantly of any surface (metallic or non-metallic), flat, curved, stationary or revolving.

It's a well-balanced instrument mounted in a sturdy case for protection against the usual hazards of on-the-job service. Jeweled movement is also heavy-duty, shock-resistant type that will withstand hard and continuous use . . . performing with laboratory accuracy.

A wide selection of thermocouples and extension arms assures its adaptation to your needs. Eight standard F. scale ranges are available up to 1200°F. Send for complete details contained in Bulletin 4257. Illinois Testing Laboratories, Inc., Rm. 514, 420 N. LaSalle St., Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

Manufactures' Representative

If you are seeking new lines, we suggest you register your name, territory covered, and present lines with this publication. We get numerous requests from manufacturers seeking representatives and by registering you pave the way to lining up desirable accounts. Write to the Research Director. AIR CONDITIONING, HEATING AND VENTILATING, 93 Worth St., New York 13, N. Y.

Students Seek Back Issues of Guide

Students in heating, ventilating and air conditioning find that even a back issue of the ASHAE *Guide* is a valuable reference book for school work.

If any readers have a 1951, or later, issue that is just collecting dust on their book shelves, why not let an engineering student have it in time for the fall semester?

Send your old *Guides* to: Prof. Frederick B. Morse, ASHAE Faculty Adviser, School of Mechanical Engineering, Purdue University, Lafayette, Indiana.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

TESTING MATERIALS MEETING—Second Pacific Coast national meeting of the American Society for Testing Materials, including an exhibit, at the Hotel Statler, Los Angeles, Calif. Fred F. Van Atta, assistant secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **SEPTEMBER 16-22, 1956.**

INSTRUMENT SOCIETY EXHIBIT—11th annual Instrument-Automation Conference and Exhibit (International), of the Instrument Society of America, at the new Coliseum building, New York, N. Y. J. McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 13, Pa. . . . . **SEPTEMBER 17-21, 1956.**

ELECTRONICS CONFERENCE—12th annual National Electronics Conference and Exhibition at the Hotel Sherman, Chicago, Ill. Victor J. Danilov, Illinois Institute of Technology, Chicago 16, Ill. . . . . **OCTOBER 1-3, 1956.**

AGA CONVENTION—Annual convention of the American Gas Association, at the Auditorium, Atlantic City, N. J. Secretary of the Association, 420 Lexington Ave., New York 17, N. Y. . . . . **OCTOBER 15-17, 1956.**

ANTHRACITE CONFERENCE—An Anthracite Conference will be held at the Mineral Industries College of The Pennsylvania State University, University Park, Pa. P. L. Walker, Jr., Department of Fuel Technology of the University, University Park, Pa. . . . . **OCTOBER 18-19, 1956.**

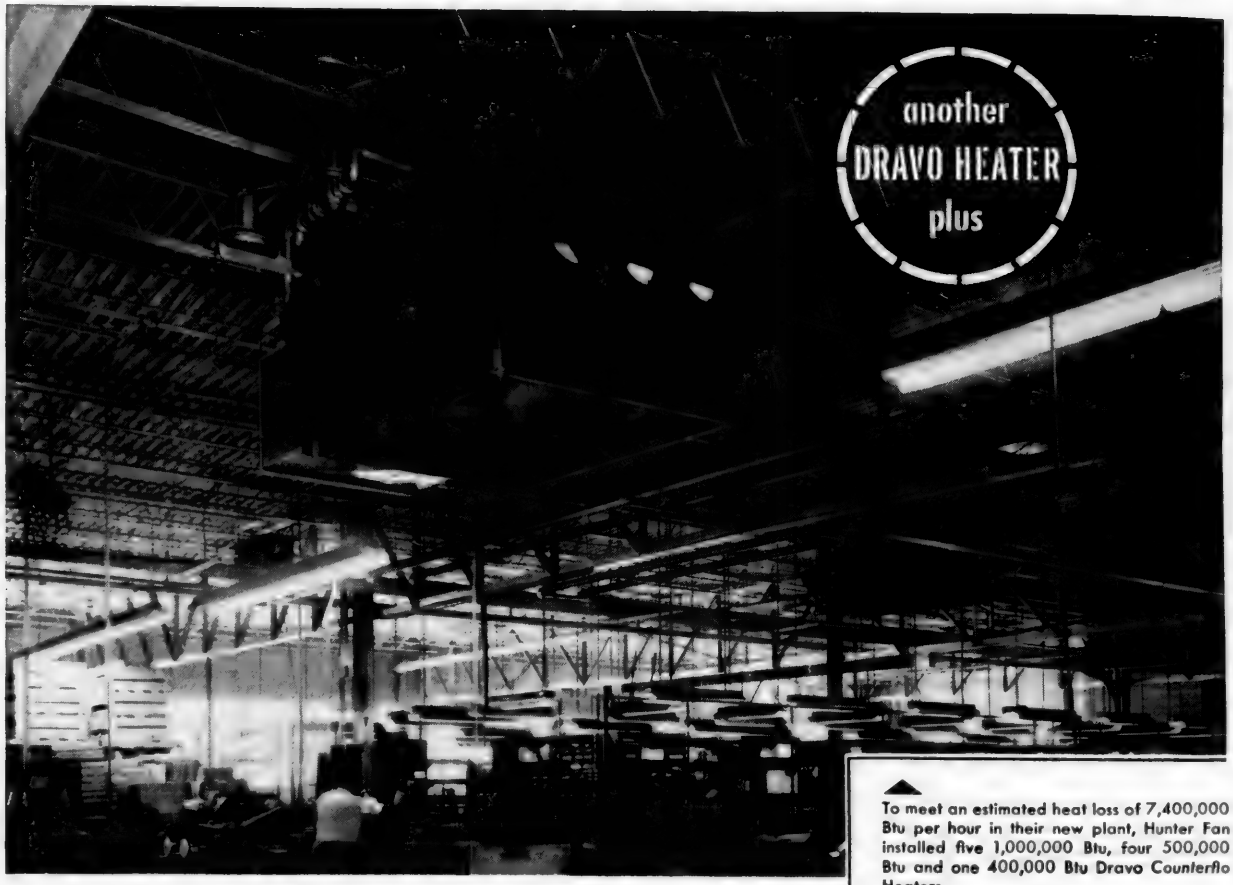
ASA MEETING—38th annual meeting of the American Standards Association, in conjunction with the Seventh National Conference on Standards, at Hotel Roosevelt, New York, N. Y. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. . . . . **OCTOBER 22-24, 1956.**

CORROSION ENGINEERS EXHIBITION—Exhibition of corrosion control materials will be held concurrently with the south central regional meeting of the National Association of Corrosion Engineers, at the Gunter Hotel, San Antonio, Tex. A. B. Campbell, executive secretary of the Association, 1061 M & M Building, Houston 2, Tex. . . . . **OCTOBER 23-26, 1956.**

AIR-CONDITIONING WHOLESALERS MEETING — Annual meeting of the Air-Conditioning and Refrigeration Wholesalers, at the Jung Hotel, New Orleans, La. Secretary, 2607 N. High St., Columbus, Ohio. . . . . **OCTOBER 24-27, 1956.**

REFRIGERATION ENGINEERS CONVENTION—Annual convention of the Refrigeration Service Engineers Society, at Hotel Muehlbach, Kansas City, Mo. H. T. McDermott, International secretary of the Society, 433 No. Waller Ave., Chicago, Ill. . . . . **NOVEMBER 15-18, 1956.**

(*Continued on page* 156)



To meet an estimated heat loss of 7,400,000 Btu per hour in their new plant, Hunter Fan installed five 1,000,000 Btu, four 500,000 Btu and one 400,000 Btu Dravo *Counterflo* Heaters.

The new L-shaped factory building, 350 by 420 feet, supplies 108,000 square feet of manufacturing and storage space. Dravo Heaters meet varying heat requirements easily despite the fact that one-sixth of plant's total wall space is window area.

Southern factory finds economical answer to plant heating problem

Much of the South's rapid industrial expansion can be credited to its year-around sunny, mild climate. But this same climate has presented some unique heating problems to manufacturing firms like Hunter Fan and Ventilating Company of Memphis, Tennessee. Their particular problem was to provide an efficient yet economical heating system for their new factory building.

In addition to the normal heating requirements, experience indicated that "chill" conditions prevailed during many winter and early spring days, particularly in the morning hours. This "part time" heat requirement indicated the need for a conventional system that could not only handle their normal needs but also have sufficient flexibility to meet these varying demands. Specifically what they needed, Hunter plant engineers decided, was a system that instantaneously handled a wide variation of heat requirements and yet was low in initial cost, maintenance, and compact enough to fit limited space in modern, low factory structure.

As cooling and ventilating specialists, they examined and evaluated all types of heaters and heating systems. Ten Dravo *Counterflo* heaters were found to be the ideal answer to their plant heating requirements.

Regardless of your plant location—East, West, North or South—you'll be dollars ahead by carefully investigating Dravo's quality heaters to see how their many features work for over-all heating efficiency and economy every day of operation. The coupon below will bring you all of the details—mail it today!

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Fifth & Liberty Avenues
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I am interested in Dravo Heaters for

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☐ Please send literature
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Company _____

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CORPORATION
Pittsburgh 22, Pennsylvania
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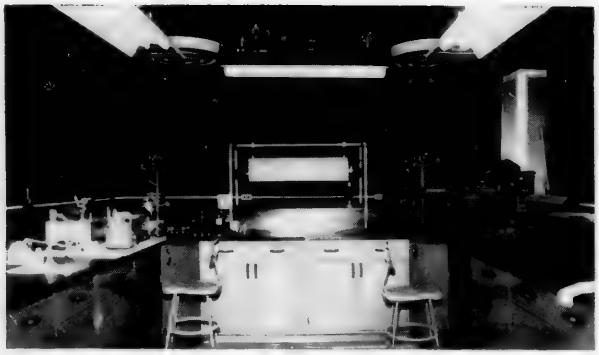


You Can Have DRY Air with EXACT Moisture Control

for your comfort, for your process, for testing machines or materials at any time of the year

Niagara Air Conditioning provides you with any temperature and relative humidity you need, held constant or varied at will. Using "Hygrol" absorbent, you save the refrigeration commonly used to condense moisture and make reheat unnecessary in most cases. It gives large capacity with compact, easily-maintained equipment.

This Niagara Air Conditioning Method dries air directly and measurably, using a moisture-absorbing liquid spray. Humidity control is a separate function from heating or cooling.

This gives you precise control over your air conditions with thermostats alone; no moisture-sensitive devices are needed. You have simpler, more trustworthy, less expensive control instrumentation. Niagara precise-control air conditioning installations have the best record for reliability.

Write for information on the application to your problem. Ask for descriptive Bulletins #112 and #121. Address Dept. HV

NIAGARA BLOWER COMPANY

405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

(*Continued from page 154*)

ASRE CONVENTION—Semi-annual meeting of the American Society of Refrigerating Engineers, at Hotel Statler, Boston, Mass. Secretary of the Society, 234 Fifth Ave., New York 1, N. Y. . . . . **NOVEMBER 25-28, 1956.**

ASME MEETING—Annual meeting of the American Society of Mechanical Engineers, Hotel Statler, New York, N. Y. Secretary of the Society, 29 W. 39th St., New York, N. Y. . . . . **NOVEMBER 25-30, 1956.**

REFRIGERATION CONTRACTORS CONVENTION — Annual convention of the Refrigeration and Air Conditioning Contractors Association, at the Balmoral Hotel, Miami Beach, Fla. Secretary of the Association, 10660 Carnegie Ave., Cleveland 6, Ohio. . . . . **NOVEMBER 26-28, 1956.**

POWER SHOW—The 22nd National Exposition of Power and Mechanical Engineering, under the auspices of the ASME, at the New York Coliseum, Columbus Circle, New York, N. Y. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. . . . . **NOVEMBER 26-30, 1956.**

CHEMICAL EXPOSITION—9th National Chemical Exposition of the American Chemical Society, in the Cleveland Public Auditorium, Cleveland, Ohio. Secretary of the Chicago Section of the Society, 86 E. Randolph St., Chicago, Ill. . . . . **NOVEMBER 27-30, 1956.**

WARM AIR HEATING CONVENTION—Annual convention and committee meetings of the National Warm Air Heating and Air Conditioning Association, at the Netherland Plaza Hotel, Cincinnati, Ohio. George Boeddener, managing director of the Association, 145 Public Square, Cleveland 14, Ohio. . . . . **NOVEMBER 27-30, 1956.**

ASHAE EXPOSITION—International Heating & Air-Conditioning Exposition, at the International Amphitheater, Chicago, Ill. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. Exposition held in conjunction with the 63rd annual meeting of the American Society of Heating and Air-Conditioning Engineers, Inc. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **FEBRUARY 25-MARCH 1, 1957.**

CORROSION ENGINEERS MEETING—13th annual conference and exhibition of the National Association of Corrosion Engineers, at Kiel Auditorium, St. Louis, Mo. A. B. Campbell, executive secretary of the Association, 1061 M & M Building, Houston 2, Tex. . . . . **MARCH 11-14, 1957.**

METALS CONGRESS AND EXPOSITION—10th Western Metal Congress and Exposition, sponsored by the American Society for Metals, and other technical groups, at the Pan-Pacific Auditorium and the Ambassador Hotel, Los Angeles, Calif. W. H. Eisenman, managing director of the Society, 7301 Euclid Ave., Cleveland 3, Ohio. . . . . **MARCH 25-29, 1957.**

GAMA MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at The Greenbrier, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. . . . . **APRIL 8-10, 1957.**

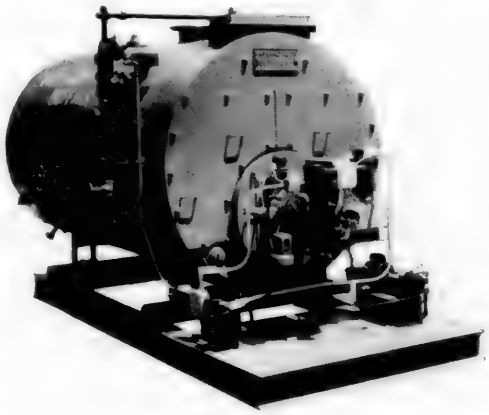
REFRIGERATION INSTITUTE MEETING—Annual meeting of the Air-Conditioning and Refrigeration Institute, at The Homestead, Hot Springs, Va. Executive secretary of the Institute, 1346 Connecticut Ave., N. W., Washington, D. C. . . . . **MAY 6-8, 1957.**

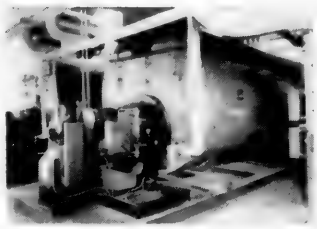
DESIGN ENGINEERING SHOW—Design Engineering Show to be held at the Coliseum, New York City. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. . . **MAY 20-23, 1957.**

TESTING MATERIALS MEETING—60th annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **JUNE 16-21, 1957.**

ASHAE MEETING—Semi-annual meeting of the American Society of Heating and Air-Conditioning Engineers, Inc., at Murray Bay, Quebec. A. V. Hutchinson, executive secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **JUNE 24-27, 1957.**

CIVIL ENGINEERS EXHIBIT—Annual meeting and Civil Engineering Show of the American Society of Civil Engineers at Hotel Statler, New York, N. Y. Secretary of the Society, 33 W. 39th St., New York 18, N. Y. . . . . **OCTOBER 14-18, 1957.**





Two BISON Super Scot Low-Pressure Boilers at Sylvania Electric Products Inc., Batavia, N. Y. Engineers and General Contractors, Siegfried Construction Co., Inc., Buffalo, N. Y.; Heating Contractors, Joseph Davis, Inc., Buffalo, N. Y.

BISON

SUPER SCOT BOILERS

for packaged heating units

To the best in the century-old Scotch Boiler with its tried-and-true two-pass design, BISON Super Scot Low-Pressure Boilers offer a number of advantages made possible by their exclusive features.

Per unit of heating surface, Super Scot Boilers are bigger. They have a larger furnace, more steam space and water content. The area directly exposed to the radiant heat of combustion is a greater percentage of the total heating surface. Certified ratings are moderate but extra loads can be handled with larger burners.

Results—smokeless combustion, extra capacity for peak loads, lower maintenance, longer life and less cost of steam generated.

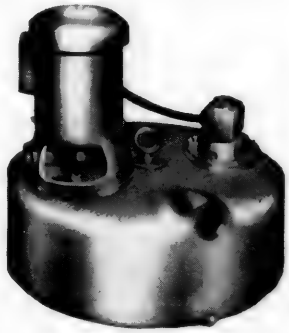
Consult F & T also for high-pressure boilers.

FARRAR & TREFTS DIVISION
ADSCO INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

As Simple as ABC

A COMPLETE UNIT

LOW RETURN
LOW SPEED
LOW WATER LINE



CAST IRON RECEIVER – for long life!

A RETURN

DISCHARGE B

C ELECTRICAL

A — One return line connection

B — One discharge line connection

C — One electrical connection

The TVC Condensate Pump is a low speed (1750 R.P.M.) pump for long life and trouble free service.

The unit is completely factory assembled for a simple A-B-C installation.

The low return connection and compactness of the unit provides for simple installation in all locations – particularly where space is limited.

DIMENSIONS

Single unit—21" diameter receiver; height of return above floor only 6⅞".

Duplex unit—25½" diameter receiver; height of return above floor only 7⅜".

Send for Bulletin TVC-300

CAPACITIES FROM 500 to 10,000 Sq. Ft. E.D.R.

Available from Jobber's Stocks!

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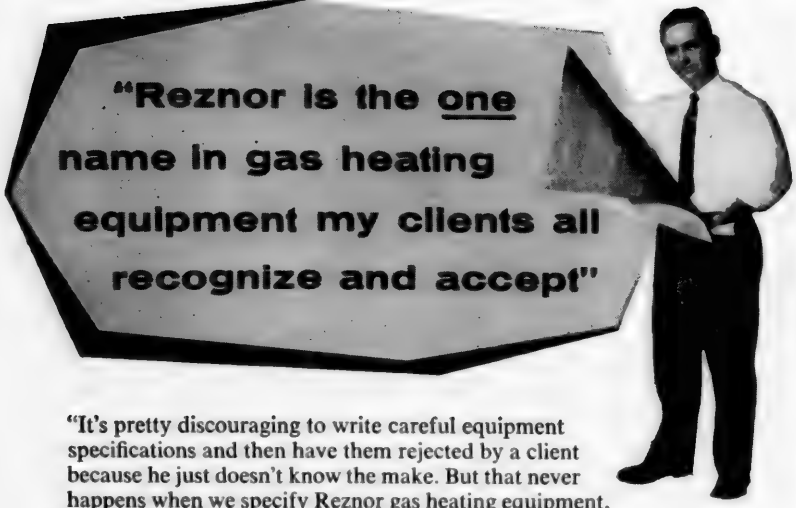
1516 N. Fremont St., Chicago 22



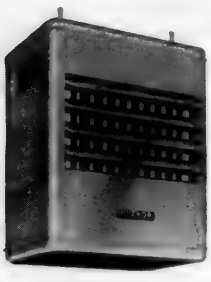
"It's pretty discouraging to write careful equipment specifications and then have them rejected by a client because he just doesn't know the make. But that never happens when we specify Reznor gas heating equipment. Reznor is the one make all our clients know and accept. It's not hard to understand why. Reznor sells nearly one out of two gas unit heaters, so Reznor is the unit heater our customers are used to seeing wherever they go. And Reznor is the brand they see advertised in the national magazines they read.

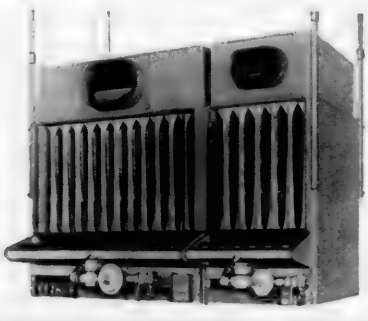
"Client acceptance is only one of the reasons we specify Reznor equipment. We know from experience that Reznor stands for quality of construction and performance. High operating efficiency . . . long life . . . dependable service.

"We like to work with Reznor because it gives us one source for all our gas heating equipment needs . . . suspended gas unit heaters for all industrial and commercial heating requirements . . . gas-fired duct furnaces which let us custom engineer heating and heating-cooling systems to meet exact job requirements.

"We appreciate Reznor availability, too. There's a stocking Reznor distributor in every major city. We know we can specify Reznor equipment with complete assurance that the units we specify will be available when and where they're needed."

Yes, Reznor is the preferred line of gas heating equipment . . . preferred by clients, by architects, engineers and heating contractors. If you don't know Reznor, it's time you got acquainted. Write today for free catalog or give your nearby Reznor distributor a call. You'll find him listed under "Heaters-Unit" in the yellow pages of your telephone directory.





REZNOR
THE WORLD'S LARGEST-SELLING GAS UNIT HEATERS
REZNOR MANUFACTURING COMPANY
64 Union Street, Mercer, Pa.

NEW CATALOGS

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

REFRIGERATING MACHINE — Engineering data for a new hermetic centrifugal refrigerating machine is presented in an illustrated catalog, No. 19C-100, published by Carrier Corporation, Syracuse, N. Y. The book is designed to assist architects and consultants. Tables for selecting the right combination of compressor; cooler and condenser in accordance with desired entering and leaving water temperatures are provided. Dimensions covering height, length and depth plus a detailed listing of weights for essential components when rigged, shipped or in operation are included. Control information with wiring diagram and a number of water nozzle arrangements and mechanical features of the machine are graphically outlined. Cutaway drawings show key parts of the cooling unit. ---------- **Item 67**

FASTENER DIAGRAMS—The first group in a series of diagrams showing different ways in which the Ramset tool can be used are being made available by Ramset Fastening System Div., Olin Mathieson Chemical Corp., New York, N. Y. In this series applications including the fastening of acoustical ceilings, steel roof decking, steel deck plates, duct straps, electrical junction and switch boxes and surface wire raceways are discussed. Other ways of using the tool will be shown in the future. The pages are designed for loose-leaf filing. ---------- **Item 68**

DEFROST EQUIPMENT DATA—A 4-page data sheet (Catalog C-C. 512) on Hot Shot automatic electric defrost equipment is available from Drayer-Hanson Div., National-U.S. Radiator Corp., Los Angeles, Calif. The data sheet includes a photo of the unit, a performance and dimensional data chart for Freon 12, dimensional diagrams, full specifications, and a complete wiring diagram. ---------- **Item 69**

REFRIGERATION LITERATURE — Three pieces of literature describing two Copelametic motor-compressors and a new condensing unit for air conditioning or other high temperature applications, have been made available by Copeland Refrigeration Corp., Sidney, Ohio. Two pieces provide specifications and performance data for new 3-hp and 10-hp, F-22, suction-gas cooled motor-compressors, especially applicable for packaged air conditioners. A third piece describes the 10-hp, F-22 remote condensing unit with a suction gas-cooled motor-compressor. ---------- **Item 70**

BURNER CONTROL BULLETIN—Bulletin CF-21, describing Fireye primary control system FJ-2, for light oil or gas-fired automatic commercial burners, is available from Electronics Corporation of America, Combustion Control Div., Boston, Mass. The bulletin contains operating data on the flame safeguard and programming system and is illustrated with both photos and drawings. It will fit into any standard-size notebook. ---------- **Item 71**

(*Continued on page 160*)

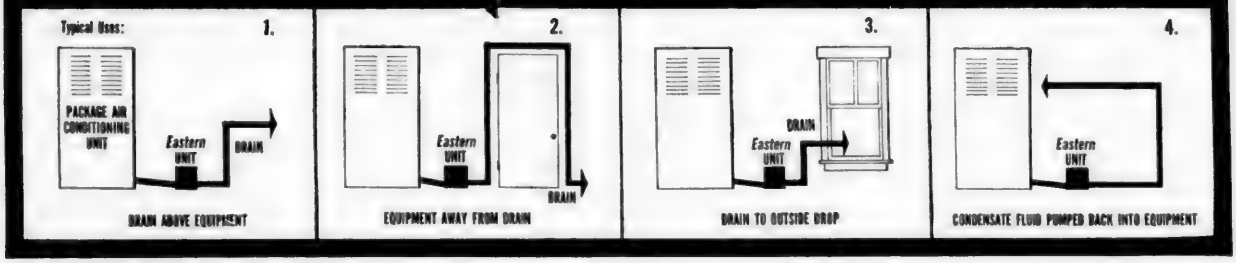
REMOVE CONDENSATE WATER

FROM AIR CONDITIONING SYSTEMS

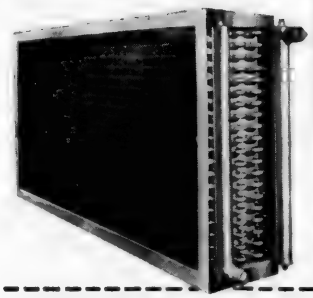
A completely automatic, foolproof unit designed to remove hot or cold condensate fluids from the receiver tank and pump it to an outside drain. Simple to install with air conditioning equipment, it gives quiet and reliable performance.

Eastern Model 3, Type 100:
Tank capacity 0.8 gallon. Centrifugal pump delivery approximately 4½ GPM at 0 P.S.I. and shut off of 12½ P.S.I. Motor 1/40 H.P., 115 volt. Weight 23 pounds. Mercury control switch. Size 5⅛ inches wide, 10 inches long, 11¾ inches high.

EASTERN INDUSTRIES, INCORPORATED
100 SKIFF STREET, HAMDEN, CONN.



. . . BUILT FOR *Outstanding Performance*



REMPE COILS

Designed to rigid specifications to insure long, trouble-free life.

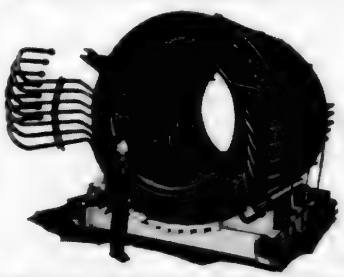
FIN TYPE COILS

For Air Conditioning, Refrigeration and Heating — available in copper or steel hot galvanized — any size, any style.

PIPE COILS

Complicated assemblies or production runs of coils or bends from any type of pipe or tubing.

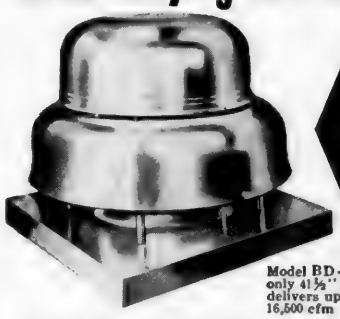
Send details for prompt quotation



HEAT TRANSFER EQUIPMENT
REMPE CO.
CHICAGO

REMPE COMPANY
358 N. Sacramento Blvd.
Chicago 12, Illinois

Get the same air delivery with only ⅓ the weight!

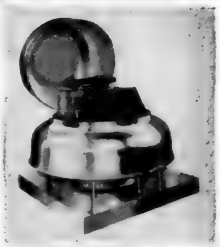


Model BD-43 is only 41½" high, delivers up to 16,500 cfm

New COOK all-aluminum belt-drive centrifugal ventilator

- Saves up to 400 lbs. on large models
- Only 6" high roof curb required
- Weatherproof aluminum shell and base
- Aluminum centrifugal wheel
- Compact belt-drive
- Low silhouette
- Non-overloading wheel, low tip speeds
- Rubber-mounted drive assembly
- From 1,000 to 16,500 cfm

The new Cook Model BD belt-drive ventilator eliminates heavy roof loads. Model BD-43, 16,500 cfm size, weighs only 250 pounds. Low tip speeds assure quiet operation. Light starting torque of the aluminum blower wheel increases bearing, motor and belt life. Are also available in Direct Drive Models from 7" to 30" sizes. Write for Catalog HV.

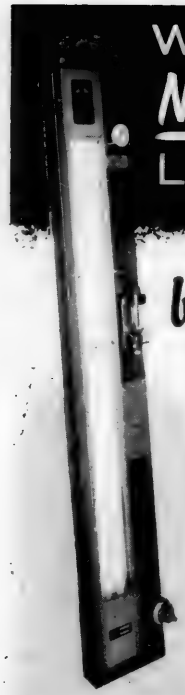


HINGED HOOD, motor and belt-drive easily inspected.

EASY TO CLEAN. Remove four bolts and shell lifts off.

COOK VENTILATORS
LORENZ COOK COMPANY
Berea, Ohio

Cook Ventilators are shown in the 1956 Sweets' File



Which of these
NEW PETROMETER
Liquid Depth Gauges

best suits your installation?

You can obtain new Petrometer Series 1400 Remote Reading Tank Gauges in 4 Models to suit almost every industrial installation. All gauges operate on the sound principle of hydrostatic pressure . . . no moving parts or intricate mechanisms to cause failure through wear, corrosion or friction. Large, vertical scale gives accurate, easy-to-see readings.

Gauges can be installed on tanks above or below the ground and up to ¼ of a mile away.

CHOOSE FROM THESE 4 MODELS

MODEL 1400 A

Equipped with aerating valve for semi-automatic purging of the transmission line. Purging line attaches to compressed air line.

MODEL 1400 B

Equipped with Bubbler as well as aerating valve. Transparent Bubbler provides a constant visual check on aeration. Used with compressed air source.

MODEL 1400 F

Equipped with Flowmeter and aerating valve. Actual rate of flow of air for purging can be preset and indicated on the Flowmeter. Requires compressed air supply.

MODEL 1400 M

For use where compressed air source is unavailable. Equipped with Manual Air Compressor and Aerating Valve.

Petrometer Gauges can be obtained in multiple units incorporated on a single panel and mounting plate to meet your specifications. High-level — low-level alarms also available.

For complete information, send for Bulletin 6004.

Petrometer CORPORATION

43-22 TENTH STREET, LONG ISLAND CITY 1, N.Y.

NEW CATALOGS

(*Continued from page 158*)

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

ROOF VENTILATOR BULLETIN — Detailed information with performance tables explaining the operation of the axial Silent-Vent roof exhauster is contained in a bulletin, DWA-101, issued by Detroit Blower Co., Franklin Park, Ill. Ventilating principles and the exhaust dissipation operating principle behind the vaned ventilator head are explained. ----**Item 72**

CONDENSER BULLETIN — The publication of a bulletin, U210D, introducing the Giant All-Season Unicon, remote-type condenser for big jobs, is announced by Kramer Trenton Co., Trenton, N. J. The bulletin is the latest of a series published since the introduction of the Unicon 19 years ago, and contains complete application information, specifications and selection charts covering all sizes up to 300 tons. Also described is the operation of the all-season Winterstat designed to automatically maintain an adequately high, constant head pressure at the expansion valve, regardless of the outside air temperature and without seasonal or daily adjustments. ----**Item 73**

PAMPHLETS ON V-BELTS—Part of a series of five self-mailers intended to help users of V-belt drives diagnose common causes of trouble are offered by Worthington Corp., Harrison, N. J. The mailers are sized to be tacked up on the wall near a drive or on the machinery itself for reference. Mailer No. 2 is designated V-1400-M38P and No. 3 is designated V-1400-M40P. ----**Item 74**

RESIDENTIAL BOILER CATALOG — Eleven models of the 700 Series residential steel boilers made by Pacific Steel Boiler Division, Johnstown, Pa., are described and illustrated in the recently issued Catalog AP-296. The back page of the new catalog shows architectural drawings relative to product dimenisons and roughing-in data. A complete listing of tank type and instantaneous domestic water heaters to use with boilers is featured in the catalog. ----**Item 75**

BROCHURE ON POWER EQUIPMENT—A line of power transmission equipment is described in a 12-page technical brochure offered by Lovejoy Flexible Coupling Co., Chicago, Ill. The information contained in the publication includes operating data, horsepower ratings, sizes, and types. ----**Item 76**

INDUSTRIAL FAN CATALOG—A line of industrial fans, designed to handle corrosive and explosive fumes, high temperatures and humidity, abrasive dusts and dirt-laden air, is featured in a bulletin compiled by Propellair Div., Robbins & Myers, Inc., Springfield, Ohio. The 6-page bulletin describes the applications for the belt-driven tubeaxial fans and the requirements for their use under special conditions. ----**Item 77**

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

WATER CHILLER BULLETIN—A revised Cold Generator bulletin covering its line of 10 through 150 hp packaged, reciprocating water chiller units for industrial and commercial, comfort or process applications, is available from The Trane Company, La Crosse, Wis. It includes new capacity tables on the company's 10, 20 and 50-hp machines, which now have an internal fin extended surface arrangement and new data on 60, 75 and 100-hp Cold Generators, redesigned to use straight tube condensers with removable heads. Also included is information on chiller inlet and outlet water connections, which have been increased in size, and data on the two largest size packaged units—the 125 and 150 hp machines. ----------**Item 78**

FAN BASE CATALOG—A line of vibration mountings and fan and motor bases is described in a catalog (FR-55) issued by T. R. Finn & Co., Inc., Industrial Div., Hawthorne, N. J. Detailed descriptions of design features are given and include the high deflection rubber-in-shear isolators, channel supports and the like. ----**Item 79**

CONDENSER BULLETIN—Bulletin AC3, introducing a line of heavy duty, air-cooled condensers for use with Freon-12 and 22, and with capacities to 200 tons of refrigeration, is available from M. Blazer & Son, Passaic, N. J., distributors for Tru-Air Corp., Passaic, N. J., the manufacturer of the condensers. --------**Item 80**

AIR FILTER CATALOG—An air filter and accessories catalog is published by Air Filter Corp., Milwaukee, Wis., with a table of contents listing the bulletin number for each item described in the catalog. A slide ring binding allows for the addition of new bulletins. ----------**Item 81**

TUBING STRESS VALUES—Engineers associated with the design of equipment involving the use of tubing at elevated temperatures and pressures are offered a technical data folder (TDC-154A) published by Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa. The folder gives the maximum allowable stress values for ferrous pipe and tubing at various temperatures. Also included in the folder are the formulas to be used in calculating the maximum allowable working pressures. ----------**Item 82**

COOLING TOWER CATALOG—A 12-page catalog on the MT line of cooling towers is offered by Baltimore Aircoil Co., Baltimore, Md. The catalog covers twenty-three sizes from 10 to 400 tons for air conditioning and refrigeration applications. The construction and components of the units are described in detail, utilizing illustrative photographs. ----------**Item 83**

ASH HANDLING DATA—A line of Hydroseal pumps for hydraulic ash handling systems is described in data sheet Pa, published by The Allen-Sherman-Hoff Co., Wynnewood, Pa. The 12-page data sheet uses photographs, schematics and line drawings to illustrate the centrifugal pumps, and tables give pumping capacities and related data, including friction loss in pipe and fittings. ----------**Item 84**

(*Continued on page 162*)

KORFUND VIBRATION CONTROL

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NEW CATALOGS

(*Continued from page 161*)

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

HEATING COIL DATA—A technical data book (bulletin No. 355) on thermal-panel coils is issued by Thermal-Panel Div., Dean Products, Inc., Brooklyn, N. Y. The 52-page bulletin discusses various subjects related to the heating coils and contains photographs. ..... **Item 85**

PLASTIC PIPING CATALOG—A 12-page catalog, illustrating and describing its line of corrosion-resistant polyethylene and polyvinyl chloride pipe, tubing, ducting, valves and fittings for industrial applications is released by American Agile Corp., Bedford, Ohio. The new literature supersedes a previous company catalog covering these products and contains additional information that was not heretofore included. ..... **Item 86**

PAPER ON WATER ANALYSIS—The publication of technical paper No. 133, on the determination of carbon dioxide in water by conductivity measurements is announced by W. H. & L. D. Betz, Philadelphia, Pa. The paper describes a method developed for the determination of carbon dioxide which is applicable to the analysis of waterside deposits, treatment chemicals, and organic carbon found in water. ..... **Item 87**

COOLING TOWER BULLETIN—Construction and operational details of an induced draft cooling tower are described in Bulletin CT-56-1, available from Foster Wheeler Corp., New York, N. Y. In addition to a three-dimensional wash drawing of a tower cell, the publication also includes perspective drawings of major equipment features. ..... **Item 88**

POWER TRANSMISSION CATALOG—An engineering catalog (D56) covering a line of mechanical power transmission products is issued by Dodge Mfg. Corp., Mishawaka, Ind. The catalog contains 328 pages of information on products, including sectional drawings, dimensions, weights, prices, application details, and engineering tables. ..... **Item 89**

REFRIGERATION UNIT BULLETIN — A revised CenTraVac Bulletin, DS-399, is announced by The Trane Co., La Crosse, Wis. The bulletin now has information on the company's largest-capacity centrifugal refrigeration machines, including capacity tables, water pressure drop charts, and engineering data. ..... **Item 90**

FAN BULLETIN—A bulletin describing Galex airfoil type draft fans is offered by The Green Fuel Economizer Co., Inc., Beacon, N. Y. The bulletin lists fans with wheel diameters ranging from 30 to 98 in. in six different designs. ..... **Item 91**

STEAM BOILER BULLETIN—Electrically heated steam boilers for producing small or moderate amounts of process steam are described in bulletin No. 55 issued by Commonwealth Electric & Mfg. Co., Boston, Mass. Boilers in sizes from 1 to 39.6 boiler hp are described. ..... **Item 92**

HEATING-COOLING BULLETINS—Two bulletins describing the HRC Spotaire series of cooling and heating units are issued by Drayer-Hanson Div., National-U. S. Radiator Corp., Los Angeles, Calif. Bulletin C-R. 5632 illustrates the units in meat-cutting and packaging rooms, and Bulletin C-R. 5625 shows a typical commercial-institutional installation of the units. ..... **Item 93**

TEMPERATURE REGULATOR DATA—A bulletin containing information on the Cash Standard Stacon Series V self-operating temperature regulator is available from A. W. Cash Co., Decatur, Ill. The bulletin contains such data as weights and dimensions, pressure and temperature ratings, accessories, construction, and performance characteristics. ..... **Item 94**

COOLING SPECIFICATION SHEET — A specification sheet that gives the dimensions, component parts, accessories, and connection sizes of 10- and 15-ton packaged air conditioners is issued by Worthington Corp., Harrison, N. J. The specification sheet is designated Bulletin No. C-1100-S81D P. ..... **Item 95**

CONTROLS CATALOG—The second edition of its general catalog (D-31) is released by Automatic Temperature Control Co., Inc., Philadelphia, Pa. Presented in the catalog is a complete picture of the products and services offered by the company. ..... **Item 96**

PUMP BULLETIN—An 8-page bulletin (No. 111) describing APCO Master turbine-type pumps is released by Aurora Pump Div., The New York Air Brake Co., Aurora, Ill. The bulletin shows assembled and exploded views of the turbine-type pumps, cross sections of single and two stage pumps, and features construction specifications for pump parts. ..... **Item 97**

HEAT TRANSFER DATA—A heat transfer bulletin (HE) issued by Downingtown Iron Works, Inc., Downingtown, Pa., contains data and illustrations of interest to designers and users of custom built heat transfer equipment. Included are a table of heat transfer rates for various duties, tube sheet layout tables and a sample calculating sheet. ..... **Item 98**

RECTANGULAR BURNER BULLETIN—A bulletin describing a line of rectangular gas conversion burners is offered by The Barber Mfg. Co., Gas and Oil Burner Div., Cleveland, Ohio. The bulletin lists the specifications, dimensions and approximate shipping weights of the various models in the line of burners. ..... **Item 99**

SPRAY NOZZLE CATALOG—Industrial spray nozzles and accessories have been cataloged by Monarch Mfg. Works, Inc., Philadelphia, Pa. The 20-page catalog contains expanded capacity charts and information on previous standard items plus numerous new items which have been added to the line. It also includes a line of strainers. ..... **Item 100**

BULLETIN ON WEATHER CONTROLS—The control of building temperatures from outdoors is the subject of a 4-page, illustrated bulletin (No. C-256) issued by Automatic Devices, Inc., Western Springs, Ill. The catalog describes in detail, and with diagrams, the manufacturer's complete line of outdoor controls ..... **Item 101**

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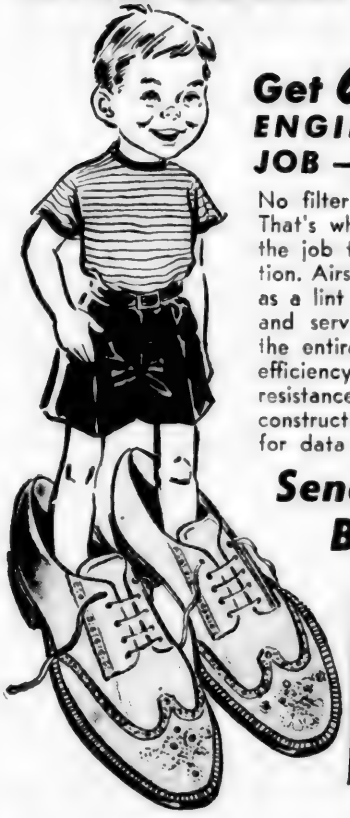

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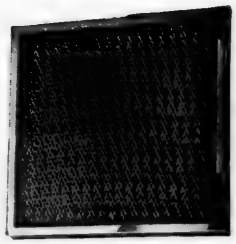

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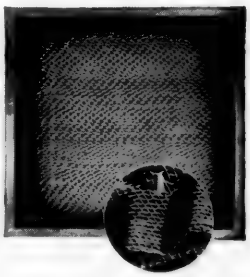

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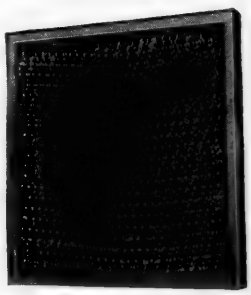

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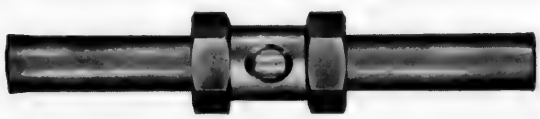

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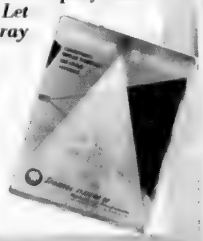

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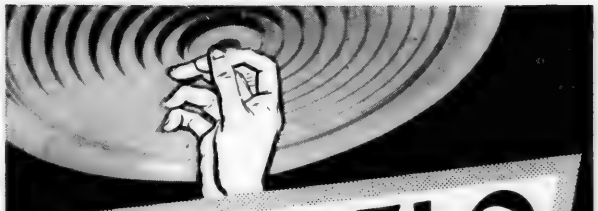

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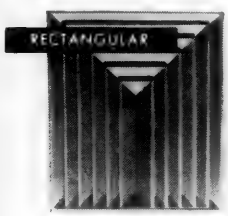

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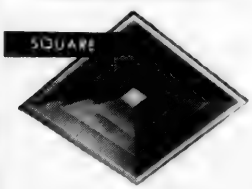

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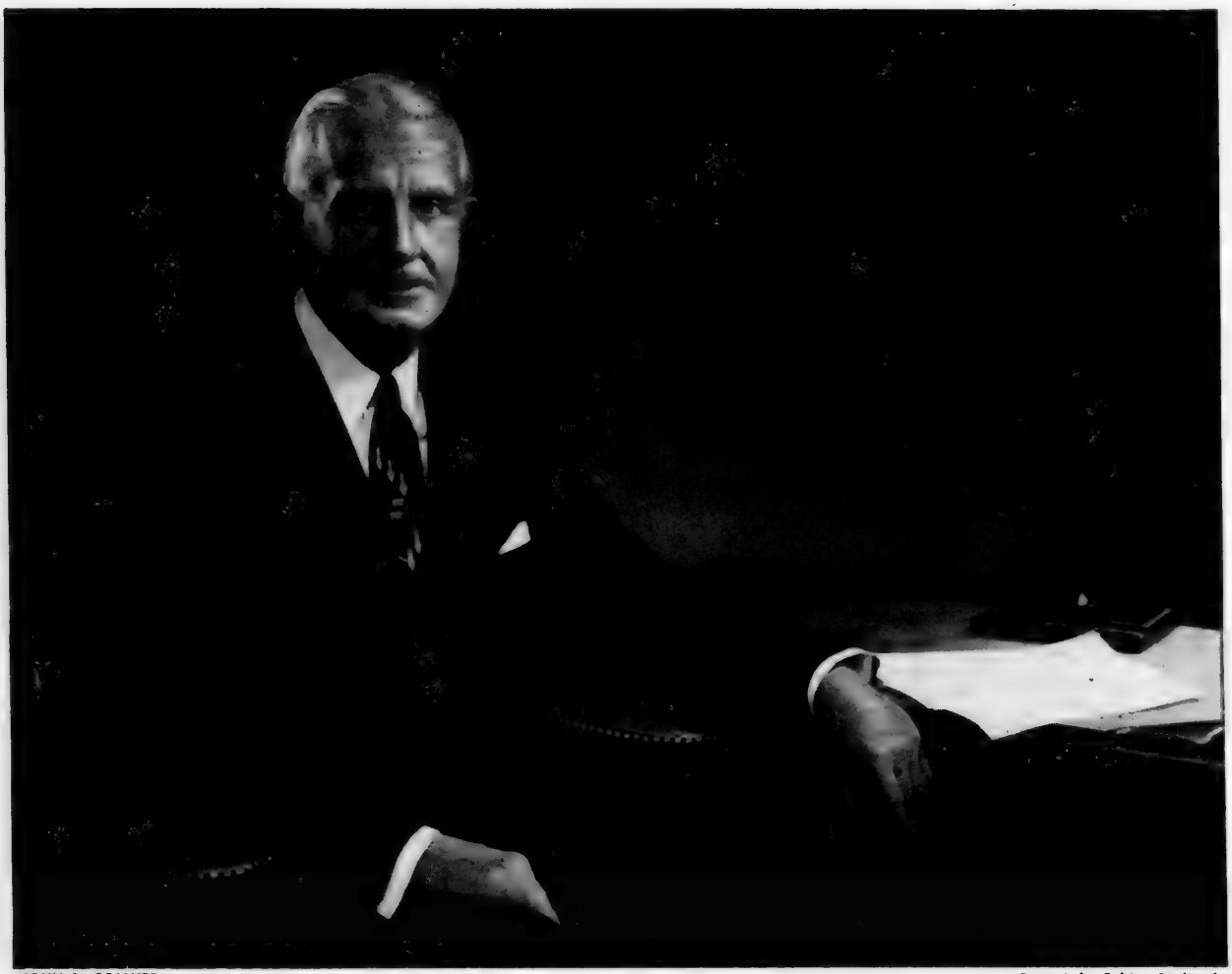

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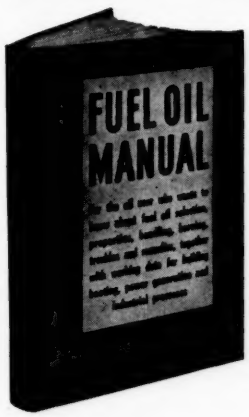
Fuel Oil Characteristics and Uses



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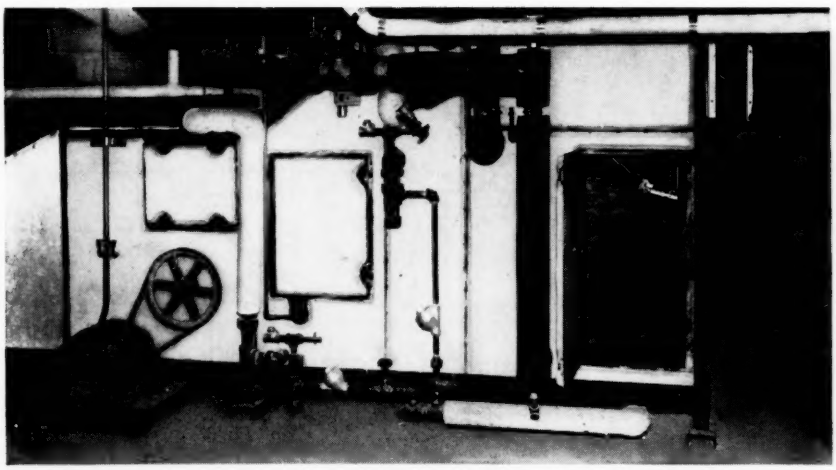

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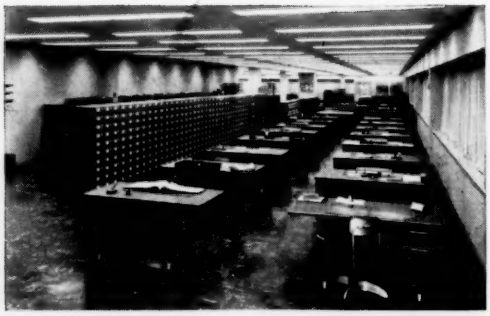

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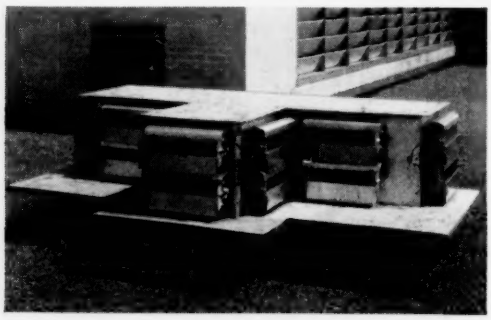

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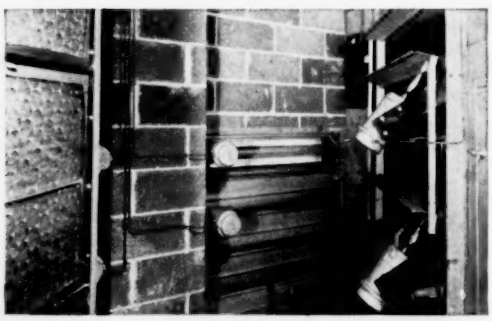

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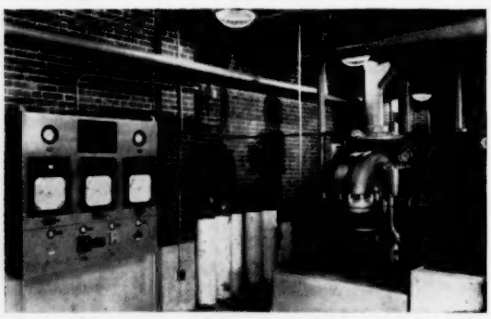

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